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**THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.**

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## NOTES AND COMMENTS.

### The Cost Price of Liquid Metal.

To find the cost of a ton of liquid iron or steel in the ladle is no easy problem, but it is possibly less complicated and relatively less important than the establishment of a figure for bronze and brass. It has been stated that in one of the most important foundries making brass and bronze ingots for rolling and drawing, the discard converted to money is quite equal to all the manufacturing costs—overhead, labour, stores, maintenance, power, etc.—but, of course, excepting the cost of raw material.

Much divergency of opinion exists as to the establishment of a base figure for the cost of metal leaving the furnace. Some firms work on the system that if they charge in 100 lbs. of bronze at 25 pence per lb., and they cast 95 lbs., then the cost price per lb. is counted at 26.3 pence. Others, going a little farther, work it out on these lines: the 95 lbs. of bronze only gives 60 lbs. of finished castings, the balance, 35 lbs., representing scrap in the shape of runners and risers, etc. This scrap is passed back to the furnace, and is subject to a further 5 per cent. loss, making the real loss nearly 8 per cent. Naturally, in both cases, the price is increased by the addition of labour, power, fuel, and refractory material costs. A writer in a recent issue of "La Fonderie Moderne" suggests that the furnace should be considered as a separate organisation, with a distinct costs department. Such a system makes the furnace at the same time a customer and a supplier of the dispatch stores. It should have an account opened as if it was an ordinary buyer, being debited with all it consumes and credited with its product.

Taking the case of a furnace melting 60/40 brass, the furnace would be debited with (1) bought scrap to which transport costs should be added; (2) bought or own machine-shop turnings; (3) foundry scrap; (4) zinc and red copper.

On the other side, the furnace would be credited with foundry scrap at a price slightly lower than current, and good castings entering the dispatch stores, no notice being taken of its cost price.

Thus a fortnightly account would appear in the following form, using entirely fictitious figures:—

*Debit.*

| | | | |
|---|---|---|---|
| 5,990 lbs. of bought brass at 1s. 1d. | £324 | 9 | 2 |
| 2,368 lbs. of brass turnings at 6d. | 59 | 4 | 0 |
| 8,499 lbs. of foundry scrap at 1s. ... | 424 | 19 | 0 |
| 195 lbs. of zinc at 9d. ..... | 7 | 6 | 3 |
| | £815 | 18 | 5 |

*Credit.*

| | | | |
|---|---|---|---|
| 8,419 lbs. of scrap brass at 1s. ..... | 420 | 19 | 0 |
| 7,014 lbs. of good castings ..... | 394 | 19 | 5 |
| | £815 | 18 | 5 |

The figure of £394 19s. 5d. is obtained by subtraction to balance the account for the fortnight, and by dividing this figure by the total of good castings, then their cost per lb. will be about 1s. 1½d.

Obviously, to this figure there must be added labour, fuel, refractory material (crucibles or furnace linings), power, and small supplies (furnace tools and deoxidisers).

### Safety First in Foundries.

Exhaustive as is Mr. Bartlett's Paper, of which we give a further instalment in this issue, we find that more refinements can be brought about by still closer application to the subject. Mr. William H. Steel, writing in "National Safety News" on the subject of precautions taken in the foundry of the Locomotive Stoker Company, of Pittsburgh, points out that men could not be induced to wear goggles in the fettling shop until the lenses were made of such material that it corrected the defective sight of many of the employees. Close attention was also given to adjusting the fit so that a maximum of comfort was assured to the wearer. It is also stated that machine moulding reduced accidents by 40 per cent. This seems quite feasible, for as the work becomes routine, the liability to accidents is diminished. Though the number of employees is not given, the foundry must be fairly large, as 43 tons of metal is cast every day, and even though a special study has been made of the subject there was an average of 22 accidents per month during last year. In January, this year, however, the figure was reduced to seven minor accidents. We believe the "Safety-First" movement started in Great Britain, and if we can beat other countries in this direction it will indeed be a proud boast. A careful study of Mr. Bartlett's Paper will reveal the number of removable causes of accidents which exist in all foundries, and the Paper should go a long way towards the amelioration of foundry conditions.

XUM

# Manganese as Desulphuriser in Basic Open-Hearth Practice.

According to a Paper presented to the American Iron and Steel Institute by Mr. E. A. Wheaton, superintendent, Open-Hearth Plant No. 3, Bethlehem Steel Company, Bethlehem, Pa., steel producers in the United States are face to face with a growing scarcity of low-sulphur fuels. Many steel users are prone to attribute to sulphur in steel most of the failures experienced in service, and many manufacturers believe that the sulphur limits now current in specifications for steel represent limits which cannot be exceeded without a distinct loss of tonnage in forged and rolled products due to the "red shortness" attributed to sulphur content. An important consideration, therefore, for all factors is the problem of avoiding increases in steel sulphurs in the face of certain future increases in fuel sulphurs.

The purpose of this Paper is to show one of the phases of the experimental activities of the Bethlehem Steel Company in attempting to solve this important problem, and the particular phase dealt with herein is the partial elimination of sulphur from high-sulphur pig-iron by the use of a manganiferous burden in blast furnaces to produce pig-iron for use in basic open-hearth furnaces which shall contain enough manganese to desulphurise considerably the pig-iron in the ladle, the mixer, and the furnace. Some data are also presented tending to show the deoxidation of the open-hearth bath contemporaneously with desulphurisation.

In the face of increased difficulties in obtaining high-grade raw materials, and in the effort to produce the highest quality of steel for special service, and believing that some of the difficulties might be overcome by the use of a high-manganese pig-iron, the Bethlehem plant of the Bethlehem Steel Company undertook to operate its No. 3 open-hearth furnace for a considerable time in the manufacture of steels where the inspection and service was particularly severe, and where the effect of any improvement of quality would be most readily demonstrated. The data presented here extend over several months' experience, but particularly refer to August, 1920, as nothing but high-manganese pig-iron was used at that time.

From the data presented here the writer has drawn the following conclusions:—(1) That high-manganese iron is a help rather than a hindrance in blast-furnace practice; (2) that high-manganese iron improves the quality of open-hearth steel without reduction of tonnage or other injurious effects; (3) that to meet the demands for the better grades of steels, alloy, etc., it is of great assistance; (4) that, due to better surface conditions, steel made from it shows increased yields with ordinary rolling-mill practice.

With high-sulphur coke and inferior raw materials a blast furnace must resort to a slag rich in lime or increased slag volume in order to insure low-sulphur iron. Either alternative means low tonnage in blast furnace and high coke ratio. If the manganese in the hot metal is kept around 2 per cent., it is possible for the blast-furnace man to run his iron higher in sulphur with leaner slags, increased tonnage, and reduced fuel ratio, and at the same time deliver to the open-hearth furnace iron as low in sulphur as could be obtained with low-manganese iron cast much lower in sulphur. This is borne out by data from 136 tests run on high-manganese iron between blast furnaces and open-hearth furnace No. 3 at Bethlehem, to determine the desulphurisation which occurred in the pig-iron transfer ladle.

Table I.—*Tests on Desulphurisation.*

| Group. | Per cent. manganese in iron. | Sulphur at blast furnace. | Manganese. | Sulphur at open-hearth mixer. |
|---|---|---|---|---|
| I. | 1.00 to 1.50 | 0.0867 | 1.39 | 0.041 |
| II. | 1.50 to 2.00 | 0.0700 | 1.72 | 0.035 |
| III. | 2.0 and above | 0.0730 | 2.13 | 0.031 |

The methods used were as follows:—C blast furnace was run on high-manganese iron with lean slags, and, of course, high sulphur. A sample of this metal was taken from each ladle at the blast furnace, and from the same ladle at the open-hearth mixer. The average time between sampling at the blast furnace and the mixer was 80 minutes, which is about the average time consumed in normal operation. Altogether 136 ladles of iron were thus tested. These ladles contained varied percentages of manganese and sulphur, which have been divided into three groups, according to manganese content, as follows:—First group, iron from 1 to 1.50 per cent. manganese. Average, 21 tests. Second group, iron from 1.50 to 2 per cent. manganese. Average, 89 tests. Third group, iron from 2 per cent. and above, manganese. Average, 26 tests. From these tests, the averages of which are shown in Table I., it would seem, at first glance, that an average of 1.20 per cent. manganese is as effective as higher manganese for desulphurisation in the ladle. The pig-iron sulphur in the entire 21 heats of the first group were relatively high, thus affording better opportunity for reduction of sulphur than was afforded in a number of casts in the second and third groups. It was found also that with iron running less than 1.80 per cent. manganese, it was necessary to hold longer in the ladle than with manganese over 1.80 per cent.

The silicon on this iron averaged 1.15 per cent. This should be below 1 per cent., since it was assumed that with normal temperatures the elimination of sulphur from pig-iron in the ladle takes place under following reaction:—

Slag formed in the ladle is properly $MnOSiO_2$ (manganese silicate). Any excess of $SiO_2$ forms $FeOSiO_2$ (iron silicate). Manganese in connection with sulphur forms MnS, which, with low $SiO_2$ is broken up into Mn and $SO_2$, Mn going back into the metal, and the $SO_2$ goes into the air.

With excess $SiO_2$ we have $FeOSiO_2$ present, $MnS + FeOSiO_2 = FeS + MnOSiO$. The FeS goes back into the metal, and no reduction of sulphur takes place. In this test, dolomite was used in the runner at the blast furnace, in the place of sand, in order to keep the slag as low as possible in $SiO_2$.

With high-manganese iron, elimination of sulphur also takes place in the mixer, if the $SiO_2$ is kept low in the slag; with a ratio $SiO_2$ to MnO = 0.80 in the slag, greatest removal was accomplished, but some removal takes place with MnO to $SiO_2$ = as high as 1.20. In these tests the average removal of sulphur in the mixer was 0.006 per cent.

The general conclusions drawn from the above data are that it is possible for the blast-furnace man with high-manganese iron to run lean slags, maintain tonnage, and with sulphur in blast-furnace iron as high as 0.100, to deliver that same iron to the open-hearth furnaces through the mixer, with 50 per cent. of the sulphur eliminated.

### Open-Hearth Furnace Working.

The principal objections brought out against the use of high-manganese iron are decreased tonnage, decreased yield of ingots, scorification of furnace banks and of ladle linings. The following were results of experience at Open-hearth Furnace No. 3 at Bethlehem:—

During August, 1920, the plant was worked exclusively on high-manganese iron. They have 50-ton furnaces, and tapped 70-ton heats of ingots. The average time of heats during this month was 10 hours and 15 minutes. This included all the alloy grades, and was the best average time that was ever made. One of the reasons of this decrease in time of heats was the fact that a slag can be worked into shape quicker with high-manganese iron than with low-managanese.

Yields at Open-hearth Furnace No. 3 in August, 1920, according to grades, were as follows:—Basic carbon high-manganese, 69.77; basic carbon ordinary, 90.29; basic carbon special, 89.47; basic carbon high-silicon, 90.45; basic nickel, 88.38; basic chrome, 91.18; basic nickel-chrome, 89.89; basic chrome-vanadium, 91.64; basic chrome-molybdenum, 90.22 per cent. This was better practice than the average with low-manganese iron, which could partially be explained as follows:—The average analysis of the iron was:—Manganese, 2.10; phosphorus, 0.029; sulphur, 0.051; and silicon, 1.18 per cent., which, with the scrap charge, would give a charge of about 1.40 per cent. manganese. The residual manganese in the bath averaged 0.34 per cent. or a loss in manganese of 1.04 per cent. of the weight of the charge.

The author's experience with low-manganese iron, running about 0.705 per cent. manganese, would be a charge containing about 0.60 per cent. manganese, a residual of 0.10 per cent. manganese, or a loss of 0.50 per cent. Therefore, the difference in manganese loss of a high-manganese charge over a low-manganese charge would be 1.04 per cent. less 0.50 per cent., or 0.54 per cent. of the weight of the charge in favour of low-manganese iron.

The slag weight ran about 250 lbs. of slag per ton of charge. With normal slag on low-manganese iron, this slag contained about 16 per cent. of FeO, or 12.4 per cent. Fe, which was 1.34 per cent. of the metallic charge.

The slag on high-manganese charges showed an average of 9 per cent. FeO or 7 per cent. Fe, which was 0.69 per cent. of the metallic weight of charge. This gave the FeO loss in slag 0.69 per cent. on high-man-

ganese iron against 1.34 per cent. on low-manganese iron, or a saving of 0.65 per cent. of iron, which more than equalised the 0.54 per cent. loss in manganese due to the use of high-manganese iron.

The author was unable to explain why high-manganese iron should be harder on furnace bottoms than low-manganese iron. During the same month of August the bottom delay per heat averaged 11 min., which was lower than usual. MnO, being a base, should not affect a basic bottom. The experience with ladle linings showed nothing detrimental in the use of high-manganese iron. The average for August, of 18 heats per ladle, compared favourably with ordinary practice. A 90-ton ladle was used for a 70-ton heat, giving a large volume of slag, with slow box-pouring through 1½-in. nozzles. Box-pouring necessitates hot steel and slag.

### Effect on Quality of Steel.

While there is considerable conjecture as to the injurious effects of sulphur in the finished product, everyone will agree that both sulphur and oxygen are the cause of considerable worry to those whose task it is to convert the ingot into the finished product. Iron combines easily with sulphur, and in certain associations at certain temperatures is capable of taking it up from otherwise stable compounds. Among others, it decomposes sulphate of lime ($CaSO_4$) according to the equation:—

$$CaSO_4 + 4Fe = FeS + CaO + 3FeO.$$

The iron sulphide goes into the metal. From this it will be seen that even though we may start with a low-sulphur charge and are compelled to use high-sulphur fuel, the sulphur may get into the bath in the following manner:—All producer gas contains variable percentages of sulphur, some of which is in the form of sulphurous acid, which in the flame comes into intimate contact with the charge. In the combustion chamber a portion of the sulphurous acid is oxidised to sulphuric acid, which combines with lime to form lime sulphate. The latter can be reduced by the iron whereby the sulphur goes into the metal. When the charge in the open-hearth furnace contains a sufficient amount of manganese, there is an opposite reaction. Manganese forms with sulphur MnS, which is soluble in the slag as well as in the metal. MnS has the further property, in contact with free oxygen, of giving off $SO_2$, which escapes from the furnace with the waste gases, and the slag is robbed of its sulphur content. The data in Table II. show how, with the different

TABLE II.—*Effect of Manganese on Desulphurisation.*

| Mn in pig-iron. | Residual Mn. | Mn added | Mn obt'n'd | Gain. | Loss. | Sulphur obtained |
|---|---|---|---|---|---|---|
| 0.75–1.00 | 0.15 | 0.37 | 0.47 | 0.020 | 0.070 | 0.046 |
| 1.00–1.50 | 0.22 | 0.23 | 0.44 | 0.033 | 0.044 | 0.043 |
| 1.50–2.00 | 0.26 | 0.20 | 0.45 | 0.023 | 0.044 | 0.041 |
| Over 2.00 | 0.38 | 0.13 | 0.48 | 0.020 | 0.045 | 0.038 |

residual manganese in metal, the different degrees of desulphurisation take place. Each line represents the results of 40 heats.

The sulphur in the charge was increased with the manganese in the iron rather than decreased:—(1) Charge of 0.75 to 1 per cent. Mn averaged 0.052 per cent S; (2) charge of 1 to 1.50 per cent. Mn averaged 0.053 per cent. S; (3) charge of 1.50 to 2 per cent. Mn averaged 0.055 per cent. S; (4) charge of 2 per cent. and above Mn averaged 0.061 per cent. S. The same fuel was used on all heats.

With the nickeliferous irons used for making nickel steel:—A 0.0345 per cent. sulphur iron containing 0.66 per cent. manganese gave 0.0385 per cent. sulphur in the steel. A 0.0395 per cent. sulphur iron containing 2.35 per cent. manganese gave 0.029 per cent. sulphur in the steel. Outside of the pig-iron, other elements were the same.

An interesting experiment was conducted in Bethlehem a short time ago in connection with the removal of sulphur by manganese. Cast A2332, analysing at the blast-furnace manganese, 1.92; phosphorus, 0.120; sulphur, 0.228; and silicon, 0.65, was used directly on heats B55676 and C52237; the residual manganese in these heats was 0.31 and 0.33 per cent. respectively; the sulphur on the finished heats was 0.029 and 0.030 per cent. At the same time cast B4004 analysing manganese, 0.90; phosphorus, 0.98; sulphur, 0.120; and silicon, 0.68, was used on heat B55688, and the finished sulphur showed 0.077 per cent. All three heats were worked as nearly alike as possible in the furnace, using the same kind of fuel, scrap, limestone, charge, etc. No time was lost working down sulphur in either case.

From the above results it is concluded that manganese introduced in the pig-iron will reduce sulphur in the open-hearth charge.

### Oxygen in Steel.

Oxygen is contained in all classes of steel, but only in minute amounts. The estimation by analysis of the amount present in steel is accompanied by great difficulties. In spite of the fact that the amount of oxygen going into the steel is in small ratio to the total weight, iron takes up oxygen, and large amounts of reducing agents are not capable of hindering completely its entry. Carbon, phosphorus, and silicon, for example, act imperfectly in a basic furnace to take up oxygen.

According to the best evidence, the first indication of red-shortness in steel is noticeable with 0.01 per cent. oxygen, while a content of 0.05 per cent. oxygen renders steel unusable. According to Dickman, red-shortness due to oxygen cannot be offset by carbon, phosphorus, or silicon, but can be much reduced by manganese, which, although it does not effect complete removal, must be regarded as the best destructive agent of the ferrous oxide dissolved in the iron. We can then use manganese as a preventive agent against red-shortness by additions to the charge. This is best accomplished by the use of high-manganese iron. Dickman also claims, and this is borne out by our practice, that oxygen will not be found in steel in noteworthy quantities so long as the residual manganese remains sufficiently high (0.30 per cent.).

The phenomenon of the return of manganese from slag to metal is shown by a number of tests made at Bethlehem. These tests were taken from different heats at one-half hour intervals, and show, in most cases, the return of manganese from slag to metal.

In acid steel manufacture, a great deal has been said in the past few years about the impregnation of the bath with silicon from the slag and furnace bottom, and it has been generally agreed that an acid heat, to impregnate any large amount of silicon (say about 0.18 per cent), must be pretty free from oxides. The same may be said about reversal of manganese from slag to metal in a basic furnace; when this takes place, the heat must be pretty well cleared up, and the slag and metal must be nearly free from FeO.

Slag analyses were taken from heat B55699 at the same time as the tests for residual manganese, with the following results. The residual manganese in the first test was 0.20 per cent., and in the second test (half-hour later) it was 0.32 per cent. The decrease in MnO (5.65 in the first test, 3.95 in the second test) showed a return of manganese to metal from slag; a corresponding decrease of FeO; also a decrease of sulphur in slag due to the MnS being broken up, and the Mn returning to the metal. With iron oxides as low as this in basic open-hearth slag, one would not expect much oxygen to be found in the steel.

## Utilising Cupola Waste Heat.

A device suggested by Mr. J. McGinnis in a recent issue of the *Foundry* is essentially a damper of special form, which, by preventing the chimney effect after "dropping" the bottom, allows of the dispersal of the heat for warming up the foundry during the night. This damper rests on two bars placed between the corners of the sill of the charging door and slots cut into the brickwork at the back of the cupola. The back of the damper is curved to fit up tightly against the brickwork and the two spaces at the sides are closed by hinged plates after the insertion of the damper.

**VICTORIAN GOVERNMENT RAILWAYS REQUIREMENTS.**—His Majesty's Senior Trade Commissioner in Australia has forwarded copies of specifications, conditions, blue prints and forms of tender in connection with calls for tenders by the Victorian Government Railways, for the supply and delivery of:—(1) 1,209 steel tyres of various classes. (Contract No. 33,851.) (2) Heavy grinding machine. (Contract No. 34,114.) Sealed tenders on the proper forms will be received by the Victorian Railway Commissioners, Spencer Street, Melbourne, up to July 20. The tenders must be accompanied by a preliminary deposit of ½ per cent. of the total amount of the offer. Local representation is essential. Copies of the specifications in connection with the above tenders may be consulted by United Kingdom firms interested at the Department of Overseas Trade (Room 59), 35, Old Queen Street, London, S.W.1.

XUM

## Deaths.

The death is announced, at Newcastle, of Mr. Matthew Cockburn, commercial manager of the Palmer Shipbuilding & Iron Company, Limited. Deceased, who was only about 40 years of age, belonged to the Clyde district, and entered the service of the Palmer Company about twelve years ago.

The death has occurred at his residence, Glanfield, Sevenoaks, Kent, of Mr. John Capel Hanbury, J.P., D.L., aged 68, formerly of Pontypool. He was a descendent of Richard Hanbury, of Elmley Lovett, Worcestershire, who instituted ironworks in Pontypool district, the first works being built at Monkswood, Pontymoile, in the fifteenth century. The business was controlled by the family until 1850, when it was bought by a company and worked until the works were dismantled in 1881.

## Company News.

**Projectile & Engineering Company, Limited.** — Profit, £4,264; brought forward, £28,257; carried forward, £32,522.

**John Shaw & Sons (Wolverhampton), Limited.** — Balance dividend, 5 per cent., less tax, making 15 per cent., less tax, for year.

**Tindall Drill & Engineering Company, Limited.** — Capital £5,000 in £1 shares. Registered office: 28, Spenser Street, Westminster.

**Froggatt & Ledger, Limited.**—Capital £10,000 in £1 shares, to carry on the business of cutlery and steel manufacturers, etc. Permanent directors: J. H. Froggatt and A. F. Ledger.

**Bell Brothers, Limited.**—Profit, £265,563; brought in, £21,925; reserve, £17,088; dividend on ordinary, 15 per cent. for year; reserve for general purposes, £100,000; carried forward, £50,000.

**George Casting & Metal Company, Limited.**—Capital £5,000 in £1 shares, to take over the business carried on at 38 and 39, Moland Street, Birmingham, as the George Casting & Engineering Company.

**Joe H. Smith & Sons (Oldbury), Limited.**—Capital £10,000 in £1 shares, to take over the business of a hammerman and edge tool manufacturer carried on by J. H. Smith, sen., at Roway Lane Works, Brades' Village, Rowley Regis, Staffs, as Joe H. Smith.

**Reeve & Bayman, Limited.**—Capital £10,000 in £1 shares, to take over the business of electrical and mechanical engineers carried on by W. T. Reeve and W. G. Bayman at Plymouth as Reeve, Bayman & Company. Registered office: 13, Russell Street, Plymouth.

**Swan, Hunter & Wigham Richardson, Limited.** — Net profit, £397,139; brought forward, £52,801; final dividend, 5 per cent., making 8 per cent. for year, free of tax; reserve, £140,000; reserve for equalisation of dividends, £50,000; benefit of employés, £10,000; carried forward, £53,882.

**Kerr, Stuart & Company, Limited.** — Profits, year 1917, £25,161; 1918, £31,127,; 1919, £45,364; 1920, £38,280; ordinary dividend for four years, 12½ per cent., 1916-17 and 1917-18, free of tax, and 1918-19 and 1919-20, tax deducted. Bonus, November, 1918, 50 per cent.

**Siemens Brothers & Company, Limited.**—Final dividend, 1s. per share, making 10 per cent. for year, free of tax; capital to be increased by creation of 1,000,000 10 per cent. £1 cumulative preference shares, 300,000 to be issued to existing shareholders by way of bonus, in proportion of one fully-paid preference share for every five shares held.

**English China Clays, Limited.** — The annual general meeting, which was well attended, was held on the 18th inst. The chairman, Mr. Reginald Martin, said the position of the company was very satisfactory, and the shareholders had increasingly valuable properties. In spite of the drawbacks in connection with the coal strike, the balance-sheet would show that they had had a successful year's trading. Considerable preparation and increase to both plant and works had been made during the year, in anticipation of the revival of trade on the conclusion of the coal strike, and the directors believed that given freedom from world labour troubles the future held a promising and bright outlook. The balance-sheet indicates that total profit of £149,800 was secured, as compared with £75,000 in 1919. The allocation to reserve is raised to £10,000. The ordinary dividend declared is 7½ per cent., but to avoid depleting too severely cash resources, the distribution of balance after having paid an interim dividend of 2½ per cent is made payable in two instalments, the last being on October 1 next. The carry forward is £11,800.

The late Mr. L. Jagger, of Levenshulme, Manchester, a director of Leonard Jagger, Limited, iron merchants, left £21,096.

## Gazette.

Eastern General Welding & Brazing Works, Limited, London, E.—H. W. Alliott ceased to act as receiver. May 6.

A winding-up order has been made against the Stafford Association Engineering Company, Limited, 132, Great Portland Street, London, W.1.

Seck Engineering Company, Limited (in voluntary liquidation). Claims to Mr. F. H. Farey, 46, Basinghall Street, E.C., liquidator, by June 30.

Cardiff Hematite Iron Ore Company, Limited, in course of liquidation. Claims to Mr. E. T. Granger, 3, Dock Chambers, Cardiff, liquidator, by June 15.

Kingsbury Engineering Company, Limited, has gone into voluntary liquidation. Mr. N. W. Wild, Broad Street Avenue, E.C., C.A., is appointed liquidator.

The Midland Iron and Brass Foundry Company (Northampton), Limited, are being wound up voluntarily. Mr. A. C. Towers, Arcade Chambers, Northampton, has been appointed liquidator.

Messrs. B. Shaw and R. Shaw, brass founders and finishers, Daisy Street, Halifax, trading under the style of Bennett, Shaw & Son, have dissolved partnership. Mr. Bennett Shaw continues the business.

Messrs. Geo. Hands & Jno. Thos. Broughton, 146, Hockley Hill, Birmingham, trading as Geo. Hands & Company, stampers and piercers, have dissolved partnership. Debts by Mr. J. T. Broughton, who continues the business.

Messrs. Bennett, Shaw & Ronald Shaw, trading as Bennett, Shaw & Son, Daisy Street, Halifax, brass founders and finishers, have dissolved partnership. Debts by Mr. B. Shaw, who continues the business.

Messrs. Frdk. Edgar & Claude Loraine Tucker, trading as Tucker & Edgar, 14, Chalton Street, Euston Road, London, brass metal workers, have dissolved partnership. Debts by Mr. C. L. Tucker, who continues the business.

Messrs. Jno. Clark, Geo. Sutherland Clark, Chas. Lamond, and Walter Murray, Inverkeithing, trading as Clark, Lamond & Murray, engineers, have dissolved partnership. Debts by Messrs. C. Lamond and W. Murray, who will carry on the business as Lamond and Murray.

Messrs. Hamilton Dunn, Wm. MacKenzie Dunn, and David Shepherd, trading as H. & W. Dunn, 50, Wellington Lane, Glasgow, engineers and drawing office stationers, have dissolved partnership. Debts by Messrs. H. Dunn and W. M. Dunn, who continue the business.

The Standard Shipbuilding & Engineering Company, Limited, has gone into voluntary liquidation. Mr. A. H. Blake, Ministry of Shipping Buildings, St. James's Park, S.W., is appointed liquidator. Meeting of creditors at liquidator's, May 30, at 11. Claims addressed to liquidator personally by June 30.

The partnership between Messrs. Frank Whitworth Brierley, Jno. Sugden, Alf. Danl. Wickham, & Ashton Taylor, trading in the style of J. K. Cotton & Company, 2, Water Street, Rochdale, electrical engineers, has been dissolved. Debts by Mr. F. W. Brierley, J. Sugden, and A. D. Wickham, who continue the business.

Complimentary Dinner.—Mr. J. A. Penton, president of the American Malleable Cast Iron Association, and founder of the American Malleable Research Association, who is on a tour of Europe, was entertained to dinner at Birmingham on May 12 by the Kindred Technical and Foundry Associations of Birmingham and District, Professor T. Turner being in the chair. Sir William Bowater, who proposed the toast of "Our Guest," said Mr. Penton had come to England at a time when our industries and commercial life were undergoing a terrible crisis. Most of us thought during the war, when we saw the sacrifices all classes made for a common object, that comradeship would extend to the times of peace, but, unfortunately, as yet there was a good deal of social strife. What was wanted now was a social armistice. He wished working men would realise they were shareholders in a concern, and preferential shareholders. Mr. Penton, in his response, said the time was coming when the iron and steel business would have a remarkable and long-drawn-out period of prosperity. That was going to apply just as much to Great Britain as to the United States, and probably more, for the reason that in the United States the iron market was always pretty much their own trade. They had always exported very little in proportion to their production. He did not feel that British manufacturers had very much to fear in a competitive way from business concerns in America when it came to trade in Great Britain or in foreign countries where previous to the war they had markets. As soon as conditions became normal in both countries they would have all they could do in supplying the world's requirements of steel

# The Patternmaker's Bench Equipment.

By J. Drinkwat .

The importance of the patternmaker having a suitable bench properly equipped cannot be overestimated. It may be possible for him to turn out work on any old bench, and even good work, but it will be costly. In many shops are benches that ought to have been consigned to the scrap heap long ago, or at least reconstructed, for many an old bench can be made quite satisfactory with a little labour and some new timber. It is proposed in this article to discuss benches and the various devices which can more correctly come under the head of equipment than of tools proper.

Fig. 1 shows quite a model form of bench, strongly built and durable, and especially suit-

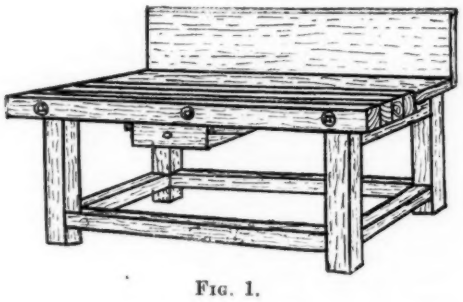

FIG. 1.

able for the patternmaker. Long benches are not really necessary unless it be in a shop which turns out big work, when a long bench is handy for planing long pieces. In the average pattern-shop a bench about 8 ft. long by 2 ft. 6 in. wide is sufficiently large. When a bench is narrow there is no room for tools, and it is decidedly inconvenient if tools have to be put away all the time. Sometimes benches are made of ash or other hard wood, but spruce is quite satisfactory with—and this is important—a yellow pine top-

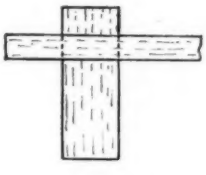

FIG. 2.

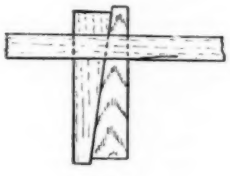

FIG. 3.

board. The best method of making this is shown in Fig. 1. It is a great advantage to have a level bench when planing timber, especially thin timber, and a top constructed as shown in the sketch will never warp. It should be glued up and bolted, then planed straight. The vertical back board is useful for hanging on tools, and if a slip of timber is screwed near the top so that a slot is formed between it and the board edge tools can be rested on it. In the bench shown there is a drawer, but no vice is shown, although every bench must have a vice of some

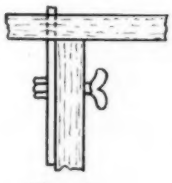

FIG. 4.

FIG. 5.

sort. The writer in a wide experience of pattern-shops has never seen one fitted with cupboards and a suite of drawers like a cabinet-maker's bench. There seems no accountable reason for this, except the greater initial cost, and it would surely be an ultimate economy, because tools could be more quickly obtained and cleared away than with an ordinary tool-box, or, what is customary in some parts of the country, a bass. It is not suggested, however, that the top of the cabinet-maker's bench is suitable for pattern-making. It certainly is not. A series of holes bored in the leg of the bench farthest from the vice into which pegs can be pushed is a great convenience when planing the edges of long timber.

The bench illustrated is the wall type, but it is usual in most pattern-shops of any size to have double benches, and sometimes three or four in one length. With double benches there should be a division of some kind, and the easiest and best kind is a suitable tool rack, such as is shown

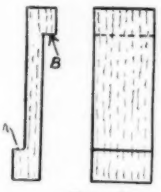


FIG. 6.

in Fig. 10. This prevents edge tools lying about the bench, and it is more satisfactory in every way than cutting a slot in the bench.

In Fig. 1 no front board is shown. Almost the only advantage of such a board, when an iron vice is used, is when an oblong slot is out towards the end of it for supporting timber when cross-sawing it, and it may be admitted that in very few pattern-shops nowadays is it necesary to use the hand-saw.

A rather important item in bench equipment is the bench stop. Some craftsmen are quite con tent to sprig a piece of thin wood on the bench, and the repeated planing of the nail heads does not cure them of a very bad practice. The same type of craftsman spoils the top of the bench by boring into it, instead of using a pad under neath timber being worked. A very common form of bench stop is that illustrated in Fig. 2. A hole about 2 in. square is cut through the bench top and a piece of timber placed to fit tightly into it, and knocked up and down to the necessary height required. This is a crude stop, and frequently wants replacing. A much better form is the wedge style (Fig. 3). The sketch explains itself. Adjustment is quite easy, and if the stop is made of hard wood it lasts a long time. Another form is the cabinet-maker's iron stop shown in Fig. 5. The pin is held at any desired height by the sprig A, the timber

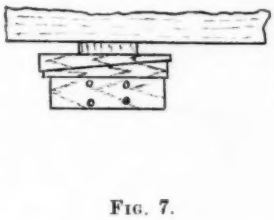

FIG. 7.

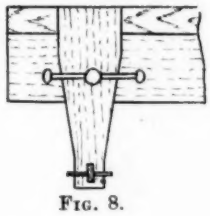

FIG. 8.

being planed against the face B. In Fig. 4 is shown a stop not very common, quite useful, but no great improvement on the wedge form. A slot is cut through the bench top and the stop, which has a rectangular slot in it, bears against the bench legs and is adjusted by means of the thumb-screw. This is more troublesome to adjust than the wedge form. A form of stop pin which has never really become popular in this country is the patent adjustable iron stop with serrated edges. Perhaps unreasonable prejudice has had something to do with this, but undoubtedly crafts-men do not like any metal about the tops of benches, and the foremen's dislike to these stops may not be unwarranted.

Sometimes a shooting board is used when tenon-sawing strips of timber, and shooting boards are not very often seen in pattern-shops nowadays. Machinery has largely superseded them. It does

often happen that strips of timber have to be sawn at the bench, and for the purpose the bench hook shown in Fig. 6 is invaluable, and can be made in two minutes. It may be 2 in. or 3 in. wide, and whilst A grips the front of the bench the timber can be placed against B. The advantage of the bench hook over the stopper for this purpose is that the bench top is not marked at all. Sometimes the board which is illustrated at Fig. 9 is used for this purpose, but the primary use is for planing thin timber. It does not matter

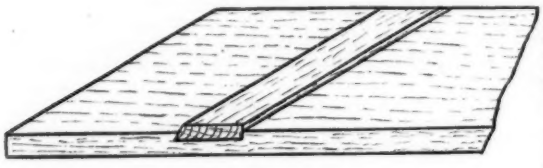

Fig. 9.

how careful a patternmaker is with the bench top, it becomes more or less uneven, and a special board with a cross strip of hardwood dove-tailed into it, as shown, is invaluable when facing timber ¼ in. or ⅛ in. thick. Such a board may be 3 ft. or 4 ft. long, and should be battened to prevent it from warping.

Every kind of vice is met with in the modern patter-shop, and no one of them combines all

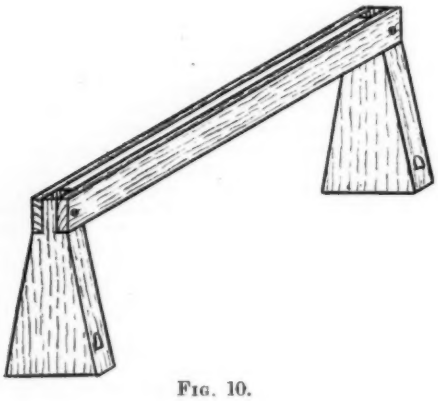

Fig. 10.

that is good. Sometimes even now the wedge vice (Fig. 7) is seen. This is a time-wasting, wholly unsatisfactory device which might serve a purpose as a temporary expedient, but that is all. For this reason it is shown the vice must be very stoutly made, or it will be quite useless, and it is necessary to have quite a stock of wedges for different thicknesses of timber.

It may not be out of place when considering bench equipment to speak of trestles. Every patternmaker's bench should have a couple of trestles, even when the work done is small. There are many times when it is much more convenient for the patternmaker to work on low trestles than on the bench top. When building comparatively large work, for instance, the bench should be kept clear for facing and edging timber, and as a repository for tools. The trestles illustrated by Fig. 11 are a good type. Sometimes the legs are set outwards, as indicated by the dotted lines, but if constructed as shown they are sufficiently strong. Bolts are better than ordinary wood screws for binding the legs to the top cross beam. The legs are occasionally cast with a wooden beam bolted on top and stayed with a long bolt to keep them from spreading. The main objection to cast-iron legs is that they are too heavy to be moved about easily.

A patternmaker's bench nowadays cannot be considered well equipped if it has not a small trimmer fastened to it. Trimmers that are used by many are never in as good condition as when used by one man only. When a trimmer is part of a bench equipment the occupier of the bench will keep it in as good condition as his planes and other edge tools, and thus it soon pays for itself because it is simply marvellous the number of operations that can be executed on a small trimming machine. Another feature of pattern-shops in the not distant future will be the equipment of benches with small planing machines. Really good machines are on the market now, which, if they are kept in good condition, almost cut out the hand plane altogether.

## Publications Received.

Birmingham Chamber of Commerce. Year Book for 1921, with trade index in English, French and Spanish.

The Frodair Iron and Steel Company, Limited, Fenchurch House, London. A booklet dealing with "Frodair" pig-iron.

Messrs. William Beardmore & Company, Limited, Glasgow. A handsome catalogue dealing with wheels and axles.

Blinded Soldiers' and Sailors' Care Committee. The Sixth Annual Report of St. Dunstan's Hostel.

The British Aluminium Company, Limited, 109, Queen Victoria Street, London, E.C.4. "Aluminium Foundry Practice."

The Perfecta Seamless Steel Tube & Conduit Company, Limited, Plume Street, Birmingham. "Current Price List of Cold-Drawn Steel Tubes for Cycles and Motors."

Messrs. Donovan & Company, 47, Cornwall Street, Birmingham. "Illustrated Price List, No. 1,421, of Electrical Fittings."

The Royal Insurance Company, Limited, 1, North John Street, Liverpool. "Rules of Golf."

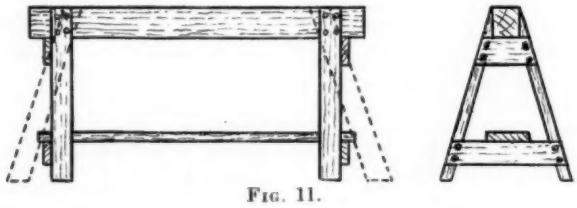

Fig. 11.

Many "lugs" (Fig. 8) are still to be seen, but they are gradually giving place to the iron vice. A good "lug" is quite satisfactory. It is so common that it is not described here. Many patternmakers still prefer it to the metal vice, but there is little justification for the preference. With the best models of iron vice the work is quickly gripped and released, and guide rods at the bottom of the jaws assist in keeping them parallel. The jaws are usually faced with wood, because wood is kindlier to wood; there is no possibility of marking, and they can be easily renewed when worn. The cam type of vice which allows of instant release is the most popular in pattern-shops.

The Phosphor Bronze Company, Limited, 87, Sumner Street, Southwark, London, S.E.1. "Railway Metals."

The Globe Pneumatic Engineering Company, Limited, 1, Victoria Street, London, S.W.1. The fifth edition of their catalogue on Pneumatic Tools.

Sir Charles H. Bedford, LL.D., D.Sc., late Director, Central Excise Laboratory for India, will read a paper before the Indian and Colonial Sections of the Royal Society of Arts on Friday, May 27, on "Industrial (including Power) Alcohol." The chair will be taken at 4.30 p.m. by Lord Southborough.

# Safety in Foundry Equipment.—Part II.*

(*Continued from Page* 451.)

By A. R. Bartlett.

*Chains and Slings.*—Reliability is the first requisite in the use of chain slings, rope slings, and every form of hoisting accessory. All chains should be carefully annealed at regular periods. It should not be assumed that reheating and cooling them adds to their strength. No such claim is made, but it will restore the fibre of the iron, if the material of which they were made was originally good. The period of annealing will vary according to the size of the chain and the amount of work it has to do. It is recommended that ½-in. chains and under should be annealed every six months, and all larger sizes every twelve months; that is, if they have been in constant use. After annealing all chains are thoroughly examined and retested before being put into use.

It is generally contended that foundry chains should be annealed more often than those in works where they are not subject to lifting hot loads. It is advised by some authorities that all such chains should be annealed every three months.

The lifting capacity of a chain greatly depends on how it is placed on the job to be lifted, and the angle of support in reference to the crane hook. Thus, if a chain is lifting perpendicularly under the hook, it will take a much greater load than if it is encircling a job. If two or more chains are used, and they are lifting at an angle of, say, 45 or 60 degrees, each individual chain will not lift as much as a similar chain that is perpendicular under the crane hook.

If chains are allowed contact with the sharp edges of castings, it will be cut and so weakened, and the ragged edges thus formed are liable to cause injury to the men handling the chain. A piece of wood or sacking will save this damage and remove the risk to the workmen, and at the same time will prevent slipping. A list of safe loads for different sizes of chains should be hung in a conspicuous position. All screw links and shackles should be hung up, otherwise the screws will get spoilt by the sand.

As it is essential that loads should be equal on each chain, wood packing or pieces of wrought iron should be placed between the links to adjust the length. On no account should knots be tied in slings or chains. A diagram should be available in the shop showing the relative strength of chains according to the angle of slinging.

Wire ropes or rope slings, no matter of what material they are made, are more reliable if spliced than if treated in any other manner, but it is essential that the man who does the splicing should be efficient.

Castings must not be slung by attaching a sling round the runner or riser, for that is usually the weakest part of the casting. Obviously, the points of the chain hooks should not be loaded. Moulding boxes should be provided with suitable handles so that the hooks can be used properly. It is the practice in some shops to lift by a lug cast on the top edge of the box, as it costs more to make boxes with handles or trunnions.

*Slingers and Crane Drivers.*—Careless or inexperienced cranemen by one false move will cause a large amount of danger and unnecessary suffering; therefore, careful, good-tempered, steady men should be employed in this capacity. A spare crane-driver and slinger should always be kept, even if they have to be paid a small retaining fee. The craneman must realise the need of thoroughly examining the crane when lubricating, for slight faults increase when neglected. The danger of doing any operation before he has orders, no matter how well he knows his work, should be impressed upon the crane driver, as the slinger can see better when the load is sufficiently high and knows where he desires to place it. He should never try to use more than two motions at once, as he has only two hands, and may have to stop at once to avoid danger.

The driver should watch the hoist drum very closely when lowering a load to the limit of his rope or chain, as he is the only one who can see properly how many turns are left on the drum; under no consideration should there be less than two turns left.

He must also exercise the same care in not winding too high and running the risk of breaking or jamming the rope-block. The slinger must warn all workmen to keep clear of suspended loads, and should walk ahead whenever possible for this purpose. Riding on suspended loads is dangerous, and should a chain break a serious accident will result. When a mould or core has to be finished overhead, rest it if possible in order to remove the strain.

*Molten Metal and Ladles.*—The ladles must be kept in good order. Ladles should be lined in a proper manner and be thoroughly dry. They should be properly balanced, otherwise they are liable to be upset when filled. All gears must be in good order so that there is no dropping when pouring. Gears should be cleaned and oiled every day before use and be adequately provided with guards. When a hole wears in a ladle, have it repaired or scrap the ladle. If the ladle is not geared it should be fitted with an efficient stop so that the bail will remain upright when the ladle is lowered on the ground, for the sudden dropping of the bail is liable to upset the ladle. The lips of the ladles should be so shaped that a perfect stream flows on pouring; a broken stream often falls outside the runner-box, and burns are frequently the result and metal is wasted.

Hand-ladles, when not used correctly, are a most fruitful cause of burns. The stream of metal should be approached from the front when catching, and when carrying from the furnace the ladle should be placed behind him, for then he can see where he is going and warn others of his approach.

Obviously, a tall man and a short man should not carry a two-handled shank. The bail of the crane ladle should be vertical before lifting from the furnace, and the slinger provided with a properly-shaped rod to guide the crane-hook into its place and sufficiently long to keep him from feeling excessive heat.

A new hand should not carry metal until he has got accustomed to seeing others do the work If much carrying is done, make it a rule that all men should keep to the left when passing. Advise men, when pouring, to keep their feet as far away as possible from the mould poured in case of a run-out. Also train them to stand firmly when pouring, for a man who alters his position is liable to burn himself and others, and also cause the stream to stop, with the result that dirt enters the mould.

*Crucibles.*—The care of crucibles, which are always delicate, should be enforced as soon as they are received by the foundryman. Inspect them carefully for flaws, and if imperfect they are useless for melting and carrying metal. All crucibles must be kept dry, if not warm. Dampness results in steam when the crucible is put into the furnace, producing cracked and burst pots. The coke should be dry before placing it round the pot when in the furnace.

Crucibles become soft and pliable during melting of the metal, so that undue pressure must not be put on them when being lifted from the furnace, otherwise a weakness is formed at the indentation, and the breaking point is started. All metal should be removed from the pots so that they have every opportunity of cooling evenly. Lift the pot on the opposite side to the lip; if lifted with tongs by the lip the pouring may be spoilt and metal lost. Clear away clinkers or clinging coke from the sides of the pot before carrying away, as they are the cause of undue pinching and possible breakage. The proper care of crucibles reduces the risk of injury to workmen.

*Machinery and Cleaning Apparatus.*—Moving parts of machinery should be protected so that they do not get damaged by the careless workman, and also to protect the workman himself. Guards should be placed wherever practicable. Notices should be placed in a conspicuous position warning men against removing guards while the machine is in motion. Belts must not be put on by an amateur or when the machine is in rapid motion; slowing down is necessary. Emery-wheels

* Lecture recently given before the Lancashire Branch of the Institution of British Foundrymen.

should be thoroughly inspected before putting them into commission, and if cracked—they are easily detected by tapping with a hammer—the wheel is useless for grinding.

The risk arising from flying chips in the trimming shop can be minimised by removing the shop as far away as possible from where men are continually passing. A chip in the eye often causes the loss of eyesight. Hammer-shafts should be securely fitted to the heads, and crowbars that have become worn at the base should be replaced, as they often slip and cause bruised fingers. In short, avoid all defective tools; impress upon all workmen to call the foreman's attention to such. Provide protective clothes or appliances, and induce the workmen to use them.

*Conclusion.*—The risks that are run should be avoided in connection with the cupola, furnaces, and stoves. The want of proper sanitary arrangements, the need of good drinking water, and some satisfactory arrangement for the storage of the men's clothes and tools are subjects which can be usefully studied for the prevention of accidents. The contented workman is more likely to be a healthy workman, and only the strong and healthy man can give the needful output to justify the outlay and thoughtfulness.

## White Metal Pattern Plates.

By S. Cooper.

The writer having made many hundreds of pattern-plates in iron, brass and white metal, is now producing pattern-plates of the last-named, at a minimum of cost for sand, etc. No special sand or eccentric mixtures are being used, and high class plates are produced in a few hours, and in some cases no filing or scraping are required on the plates before being ready for the machines. A few rubs with the scratch brush is all the cleaning required.

The method is as follows;—Black sand from the foundry floor is sieved on to the patterns through a Number 16 sieve, the sand being rather damper than for iron moulding, and should be rammed hard. After the joint has been carefully made, a little parting sand should be brushed into the face of the joint. This is best done by shaking a little through a fine muslin bag then brushing it in with a flat camel hair brush. Any excess is blown off, and finally a mere trace should be dusted over the joint again. The top should then be rammed in the usual way. After the mould has been carefully finished it should be dusted over with plumbago and well sleeked in, where possible. This is best done by rubbing it in well with the tips of the fingers, blow out the mould well, then "swab" it well with paraffin oil, top and bottom. For a plate taking a 16 by 14-in. box, about half a pint of oil should be used, but no harm will result from using more. Assuming the plate to be $\frac{5}{8}$ in. thick, it is advisable to use a direct drop runner about $1\frac{1}{4}$ in. diameter, and a riser about $\frac{5}{8}$ in. diameter. When the plate is being cast the riser must be left open and a little of the metal allowed to flow through. Very good results can be obtained by using ten parts of antimony to ninety parts of lead, this being cast rather hot. It is preferable to cast such alloys when a yellowish tint appears on the surface of the metal. If the above mixture should be too soft, further antimony should be added up to, say, 13 per cent. Should a pattern-plate contain any intricate detail work it is advisable to grind the sand a little before use. After making about half a dozen plates in the above sand it is advisable to add a little new sand in the proportion of 1 of new to 5 of black sand.

Sometimes the moulder is given one master-pattern, and possibly the plate to be made will carry several such patterns. These can be made very cheaply in plaster of Paris, as to make further master-patterns in white metal would considerably add to the cost of the plate, as for each pattern produced a separate sand mould has to be made. If a mould is made in plaster from the original pattern as many as are required can be cast in plaster from the plaster of Paris die. A few days ago the writer was given a small pattern and requested to make a plate taking a 14 in. by 11 in. box; it was found that twenty such patterns could be used on the size of plate required. Had these patterns been made in white metal it would have meant considerable delay and loss of money; a plaster mould was therefore made. The twenty master patterns were cast in plaster, then the pattern-plate was made and cast in white metal—the plate being on the machine within five hours of receiving the original pattern. Before using moulds made of plaster it is better to give the mould a coat of shellac and oil before running in the plaster. Great numbers of intricate and plain pattern-plates have been made and passed through the foundry, and it is very rarely that a pattern-plate is lost

## Mould Powders for Ornamental Castings.

A writer in a recent issue of "La Fonderie Moderne" recommends as being specially good for brass, bronze, white metal and soft iron castings an equal mixture of wood ash and spoilt flour. Both materials should be well dried and passed through a No. 35 sieve before putting into the powdering bags. The moulds should be sprinkled with this powder before pressing on the pattern in the moulds, and then, before drying, they should be treated with a light spray of linseed oil. Such a treatment makes the powder adhere firmly, and does not shift when dried. It also sticks to pattern plates and to the plaster or sand for small patterns. It absorbs humidity better than talc. The special advantage of this method is the excellency of the surface of the castings. It can also be used for green sand work, but in this case it is only necessary to treat with a water spray.

## Fish Scaling.

Among the investigations carried out by the U.S. Bureau of Standards is one designed to eliminate "fish scaling" (the peeling off of small particles) in enamels for sheet steel. A recent report says that this "fish scaling" occurs intermittently in practically all the plants manufacturing this class of material in the United States, and entails heavy losses to the manufacturers. Up to the present the Bureau has made 90 melts of enamel comprising 21 different compositions. These have been subjected to various treatments in firing and melting, and applied in various ways to several qualities of steel. In all, over 4,000 sample enamelled plates have been made. The work has demonstrated that one of the most important factors in the production of fish scaling is too severe heat treatment in the firing of the enamel. Important factors are the composition of the enamel, the physical and chemical characteristics of the underlying metal, the method of melting the chemical mixtures used in making the enamels, and the shape and weight of the metal pieces that are enamelled. These factors have been investigated to a certain extent, and will be studied more thoroughly as the investigation progresses.

## Burrowlite.

Nearly a score of metallurgists are said to have investigated the effect of a new alloy called "burrowlite" on the physical properties of steel. The alloy was discovered by the late Dr. L. P. Burrows, a mining engineer, while experimenting with nickel ores. It is claimed for it that it imparts to the steel toughness, great density, a high elastic limit, and ultimate tensile strength, either high or low elongation as desired, and machinability even when showing a Brinell number of 360 or more. The inventor brought his discovery to the attention of Mr. Daniels, Secretary of the U.S. Navy, who directed the Ordnance Department to make tests. As a result of these investigations, the alloy was used by the Navy Department during the war.

Representatives of the Union of Engineers' Syndicates, and in particular of the Syndicate of Electrical Engineers, gathered recently at the tomb of André Marie Ampère in the cemetery of Montmartre to commemorate the hundredth anniversary of Ampère's discovery of those principles of electricity which has led to many of the modern uses of the new force and has caused the name to be employed as that of the practical unit of electrical current.

## Properties of Aludur Alloys.

According to the "Anglo-Swiss Review," the Giulini Works, Limited, Basle, have for many years been making systematic investigations into the properties of metals, and have worked out new methods by which the number of useful alloys has been increased. Their processes are protected by patents in every country.

At the present time aluminium is of the greatest technical and economical interest. One result of the scientific work connected with aluminium is the light metal which has been placed on the market under the trade mark of "Aludur," and is characterised by its excellent mechanical and other properties. This is made in various qualities in order to comply with the manifold demands of engineers. The mechanical properties of the "Aludur" 570 metals are:—

| Type. | Max. Stress tons per sq. in. | Elongation per cent. |
|---|---|---|
| Aludur 570 A ... | 18.4—20.3 ... | 20—25 |
| Aludur 570 B ... | 23.5—25.4 ... | 15—20 |
| Aludur 570 C ... | 28.6—31.8 ... | 4—6 |

The specific gravity of these qualities is 2.75, and is thus not greatly different from that of commercial aluminium. Their aluminium content is greater than those of any known aluminium alloys possessing similar properties. Owing to this circumstance and to the peculiar characteristics of the process, the "Aludur" metals are not easily corrosible. Extensive tests have shown that their incorrodibility in spring water, salt water, salt solutions and other agents is the same as that of good 98-99 per cent. commercial aluminium. For the above reasons it is further possible to turn out "Aludur" metals equally with respect to their chemical composition and texture.

Type 570 A can be subjected to all kinds of treatment, such as pressure, bending and forging in cold condition; this is true to a somewhat lesser extent of quality 570 B, whereas "Aludur" 570 C can be worked up suitably without further cold treatment. Type 570 B, on the other hand, can be turned, bored and planed with ease. Type 570 BB can likewise be machined, but preferably without lubrication. "Aludur" 570 C is employed for such constructions as require the highest strength. "Aludur" metals are of advantage in all cases in which lightness of weight is an important factor side by side with strength. The relationship between weight and maximum stress of the various metals are given in the following table:—

*Table I.—Maximum Stress and Weight of Rods.*

| | Aludur. | | Commercial Aluminium. | Copper. | Brass. | Ingot iron and soft steel |
|---|---|---|---|---|---|---|
| | 570 B | 533 D | | | | |
| Specific C gravity .. .. .. | 2.75 | 2.70 | 2.70 | 8.9 | 8.4 | 7.8 |
| Max. stress in kg. per min. .. .. | 38 | 28 | 15 | 28 | 35 | 38 |
| Cross sections for the same strength | 0.74 | 1 | 1.87 | 1 | 0.80 | 0.74 |
| Weight for the same strength .. | 0.752 | 1 | 1.87 | 3.30 | 2.49 | 2 13 |
| Cut lengths for the same strength .. | 1.53 | 1 | 0.536 | 0.304 | 0.402 | 0.470 |

In general engine building "Aludur," owing to its low specific gravity, decreases the troublesome alternating stress in such parts as connecting-rods, regulating devices, lifts and hoists, as well as parts of textile and printing machinery. In all these and similar cases quicker movements and, consequently, a greater number of revolutions may be obtained with less wear and tear of the bearings and foundations. Very frequently, too, the great heat-conducting properties of "Aludur" are found to be of advantage by equalising the changes of temperatures more rapidly and preventing local overheating.

**SOCIETE HYDRO ELECTRIQUE ET METALLURGIQUE DU PALAIS.**—This Company, whose chief office is 11 bis, rue Roquépine, Paris, are negotiating for a concession for the construction of metallurgical and hydro electric works on the river Taurion, a tributary of the Vienne. Should this concession be obtained, they propose installing several electric furnaces.

## Electric Hoist Blocks.

There are many parts of foundry buildings which are of such a nature that the installation of an electric overhead travelling crane cannot be installed owing to their irregular shape, confined area and the capital outlay. Some of the advantages of a crane can be derived from the installation of an electric hoist block. Messrs. Herbert Morris, Limited, of Loughborough, have patented and placed upon the market a very handy tool, which was recently inspected by one of our representatives. The outstanding features of the apparatus are its simplicity, compactness and efficiency. The general appearance is shown in the illustration. The block can be suspended from a bracket when only required for one stationary job, such as unloading trucks at a warehouse door or serving a heavy duty moulding machine, in which case it frees the overhead crane. Mounted on a girder,

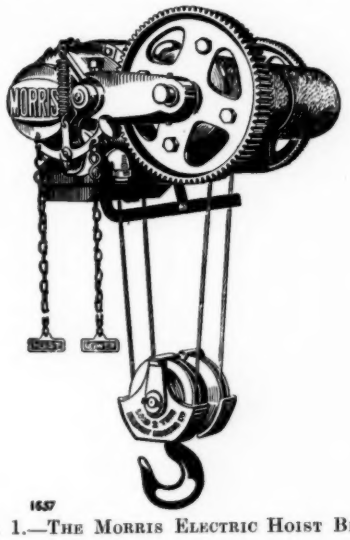


FIG. 1.—THE MORRIS ELECTRIC HOIST BLOCK.

it electrifies a manual runway, and can transform a hand crane into an electric overhead traveller.

The motor, which, when working with A.C. current, is of the slip-ring type, is totally enclosed and designed for hoist duty, whilst the controller, of the reversing drum type, is also totally enclosed and fitted with automatic fly-back release and renewable contacts. The frame is a one-piece steel casting, comprising the magnetic circuit of the motor, the bearings of the intermediate shaft and the drum shaft supports.

When the block is used as a stationary unit the current can be supplied by means of a flexible cable from some convenient point in the main. If it is required to work at different points, wall sockets have to be provided, but when working as a travelling hoist block the runway or crane girder is wired and the trolley filled with collectors to pick up the current in any position. These blocks are made in various sizes to handle loads ranging from 10 cwts. to 5 tons.

THE E. W. HARVEY GAS FURNACE COMPANY, LIMITED, of 70, Victoria Street, Westminster, have just put in operation at the St. Amand Rolling Mills, North France, two of their modern regenerative gas furnaces, each heating 20 tons of scrap iron piles per 12-hour shift, to serve a new electrically-driven bar mill for small sections. These works were dismantled by the Germans and have been rebuilt on the most modern lines.

# The Casting of Metals.—Part III.*

(*Continued from Page* 459.)

By Professor Thomas Turner, A.R.S.M.

For metals, such as aluminium, which attack quartz, Edwards and Moorman have recently employed graphite cylinders. These authors have prepared graphs showing the density of liquid aluminium from its melting point at about 659 deg. C. to 1,000 deg. C. The density of liquid aluminium at 659 deg. is 2.382, and the shrinkage of solid aluminium from 658 deg. C. to room temperature is 0.21 in. per foot. The contraction which takes place on solidification is approximately 6.6 per cent.

The majority of the metals, or single substances, appear to contract uniformly down to the freezing point; then to pass sharply, with contraction, into the solid state, and continue to contract uniformly down to the ordinary temperatures. In special cases, as shown with pure iron, by Le Chatelier, there is a definite arrest at the point of allotropic change.

*Extensometer Tests.*—Keep appears to have been the first to employ an extensometer of reasonable accuracy to foundry tests. In his method two iron pins were placed in a sand-mould, at a known distance apart, and the metal to be tested was poured into the mould so as to surround the lower part of the pins and embed them in the metal. Immediately solidification took place and the bar began to contract, the pins were drawn closer together; by two levers and a rotating drum a record was obtained in the form of a time-contraction curve. Some extremely interesting and valuable results, of an exploratory nature, were obtained; but as no corresponding temperature observations were made, it was not possible to correlate the observed expansions with the internal changes which were in progress.

In the author's experiments the castings were made in a sand-mould and one end of a T-shaped bar was fixed, while the movement of the other end was recorded by means of an extensometer. The simple form of instrument shown in Fig. 1 was quite suitable when working with cast iron, but a more accurate arrangement, with mirror and chronograph, was necessary for such tests as those of the antimony-lead series, where the changes in

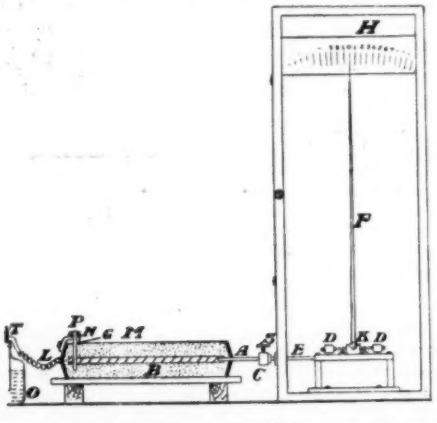


Fig. 1.—Extensometer and Mould in Position after Pouring.

M, Sand-mould in section. B, Cast bar. A, Connecting bar which projects into the metal. P, Pin held in place by nut and bolt N. O, Cold junction. T, Thermometer. L, Thermocouple leads. G, Gate, behind pin P. C, Connecting collar. S, Steel screw. E, Connecting bar. F, Pointer. K, Knife-edges. DD, Balancing weights. H, Scale.

length were relatively very small. In all cases temperature readings were taken by means of a thermocouple and accurate galvanometer.

With white cast iron only one small expansion was observed at about 700 deg C., corresponding with the separation of iron carbide from austenite with the production of pearlite. But with grey phosphoric cast iron three very marked expansions were observed, due to the separation of primary graphite, of the phosphide eutectic, and of secondary graphite respectively. These expansions correspond with definite alterations in density and physical properties in the casting. They also account for many of the fractured castings which are met with in practice, especially such as are due to faulty design.

In testing non-ferrous metals and alloys results were obtained which were more varied, and which at the time were more difficult to explain. The shrinkage tests, employing Keep's graduated wedge, showed that the shrinkage of alloys was usually less than the mean shrinkage of the constituents, and that the result obtained varied somewhat with the thickness of the bar. In other words, the rate of cooling of the casting in the mould affected the resultant volume. In some cases, however, thick and thin brass gave practically similar results.

In the extensometer tests it was observed that with pure metals no expansion was recorded, except some relatively small values, such as might be due to gas bubbles or the reheating of the original thin chilled skin owing to diffusion of heat from the interior. In passing through a series of alloys, cast in sand as described, it was generally found that definite and well-marked expansions were observed, though it was not unfrequently noted that certain alloys, like pure metals, showed no expansion in the sand-mould. Where the interval between liquidus and solidus on the constitutional diagram is considerable, there was usually a considerable expansion; while at any point where liquidus and solidus met the expansion tended to disappear.

The primary object of such observations was to ascertain what actually occurs during the cooling of a casting in the mould. Questions of constitution or of equilibrium were introduced later, but only in the attempt to explain facts which had been ascertained by oft-repeated observations. Failure to recognise what has just been stated has led to some unnecessary adverse criticism. It has also been suggested that crystal thrust or other causes may lead to the lengthening of a cast bar where no alteration of volume occurs. It is therefore interesting to discuss the question of the density of alloys, and to see how far support may be obtained for the view that certain alloys do expand when slowly cooled, while others do not behave in that way.

*Density of Alloys.*—For many of the purposes of the engineer it is essential that a casting shall be able to resist the passage of gases or of liquids in order that pressure may be maintained. Hence density is of considerable practical importance. But we may distinguish between the real maximum or true theoretical density of an alloy, and that of a casting composed of that alloy. Thus the density of common timber, when air dried, varies from about 0.37 for poplar to 0.68 for oak. But the density of all timber when the air is expelled is in the neighbourhood of 1.5, or that of woody tissue. The difference is due to the presence of air cavities. In a similar manner, though to a much smaller extent, castings contain cavities which are due to blowholes of various kinds, to inclusions of solid matter, to pipes or porosity, or to more minute and more evenly distributed interstitial spaces.

Solution or chemical combination is generally accompanied by notable change in volume, but ever since Archimedes determined the fineness of a gold crown by weighing it first in air and afterwards in water, it has been recognised that the volume of an alloy is approximately the same as that of its constituent metals. The variations from this general statement, though they may be relatively small in amount, are of considerable theoretical interest, and are sometimes of distinct practical importance.

*Aluminium Zinc Alloys: Effect of Rate of Cooling.*—In the series of experiments conducted in the author's laboratory of Mr. Teng, casts were prepared in the form of round rods of 1 in. diameter, one series being chilled by casting in an iron mould, while the others were cooled more slowly by casting in sand. The result of the experiments is given in Table 4.

* Extracted from the May Lecture delivered before the Institute of Metals on May 4.

It will be observed that: 1. In the case of the pure metal the density of the sand and chill castings were alike to three places of decimals. Any small difference which was observed only occurred in the fourth decimal place, which is well within the limit of experimental error. 2. In each set of experiments the alloys gave higher values in the chill casting than in the sand casting. 3. The general agreement between the results and the theoretical value is good, though between about 75 and 90 per cent. of zinc the chill castings are slightly more dense than the theoretical value, while they were less dense in the middle of the series. The increase of density corresponds with

TABLE 4.—*The Calculated and Observed Density of Aluminium Zinc Alloys.*

| Percentage of Zinc. | Calculated Density. | Chill Castings. | Sand Castings. | Difference Chill-Sand. |
|---|---|---|---|---|
| nil | 2.694 | 2.694 | 2.694 | nil |
| 9.86 | 2.872 | 2.850 | 2.820 | 0.020 |
| 20.60 | 3.091 | 3.055 | 3.030 | 0.025 |
| 45.25 | 3.755 | 3.564 | 3.547 | 0.017 |
| 50.24 | 3.925 | 3.867 | 3.836 | 0.031 |
| 60.40 | 4.325 | 4.248 | 4.198 | 0.050 |
| 77.50 | 5.219 | 5.328 | 5.176 | 0.152 |
| 84.85 | 5.695 | 5.716 | 5.632 | 0.084 |
| 89.76 | 6.127 | 6.143 | 6.100 | 0.043 |
| 95.20 | 6.640 | 6.630 | 6.598 | 0.031 |
| 100.00 | 7.167 | 7.167 | 7.166 | nil |

the formation of the compound $Al_2Zn_3$. 4. The lower density in the middle of the series, and the higher density towards either end as compared with the theoretical curve, is in accordance with the results of observations with the extensometer by Ewen and Turner. The maximum expansion observed on the extensometer corresponds with the maximum solidification interval, as shown on the constitutional diagram of the series by Rosenhain and Archbutt. The contraction due to the formation of $Al_2Zn_3$ is also indicated on the extensometer curve.

*Aluminium-Copper Alloys.* — The aluminium-copper series of alloys affords an interesting example of a combination of different effects.

The following conclusions are to be drawn from the data of Carpenter and Edwards, working on copper-aluminium alloys containing 0.10 to 13.02 per cent. aluminium: 1. Throughout the series chill-cast bars give results which are in close agreement with the calculated density. 2. That in all cases examined there was close agreement between the density of the chill castings and the rolled bars. 3. The sand castings had a lower density than the chill castings, except with from about 8 to 10.8 per cent. of copper. 4. This exceptional result of a slowly-cooled bar actually giving a greater density than a rolled bar is associated with the fact that over this range of composition the compound $Cu_2Al$ exists in the slowly-cooled bars, and the structure is duplex instead of being homogeneous. The change of structure is therefore registered in the altered density. If it is assumed that the compound $Cu_2Al$ dissociates, with increase of volume, at higher temperatures, the anomaly is explained. It may be added that Chamberlain, in experiments on the aluminium-copper alloys, found no expansion by the extensometer with an alloy containing 7.72 per cent. of aluminium. This is exactly what would be anticipated from the above results, since, with about that composition, sand cast, chill cast, and rolled bars all have the same density.

*Effect on Other Alloys.*—The following experiment, performed in the author's laboratory, illustrates the effect on the density resulting from slow or rapid cooling of a common brass. The composition of the metal was as follows:—Copper, 63.98 per cent.; zinc, 34.85; lead, 0.77; iron, 0.34; tin, 0.06.

When the alloy had been melted, sand castings and chilled castings were prepared, side by side, from the same pot, at the same time. The castings were rods of about 1 in. diameter. The results obtained are shown in Table 5, the metal and water being at 15 deg. C.

The calculated density from the above composition, assuming no volume change, is 8.08. Hence the contraction of volume, due to combination when the metals were alloyed, was about 7.7 per cent., while the expansion due to slower cooling was 2.95 per cent. The extensometer shows that bars of this composition, when sand cast, give a distinct, though relatively small expansion. In this particular series some of the alloys, such as those with about 15 per cent. copper, give very marked expansions indeed.

It is evident that slow or rapid cooling are merely relative terms, and that more information is required as to the effect of initial temperature and rate of cooling. Reference may be made to one experiment in this direction. By the kind-

TABLE 5.—*The Influence of Cooling on the Density of Common Brass.*

| | Sand Cast. | Chill Cast. |
|---|---|---|
| Top .. .. | 8.463 | 8.722 |
| Middle .. .. | 8.469 | 8.719 |
| Bottom .. .. | 8.471 | 8.730 |
| Average.. .. | 8.468 | 8.724 |

ness of Messrs. D. Brown & Sons, Limited, of Huddersfield, a set of test-bars was cast in phosphor-bronze. The alloy was made with pure materials and contained copper 88.4 per cent., tin 10.9, and phosphorus 0.5 per cent. The bars were about 1 in. diameter, and were poured, from the same crucible, at temperatures ranging from 1,200 deg. C. to 1,000 deg., at intervals of 25 deg. A chill-cast bar was also poured at 1,150 deg. From these bars pieces were prepared, and the density determined by Mr. Bailey. His results are given in Fig. 2. It will be seen that as the temperature of pouring fell from 1,200 deg. to 1,125 deg. the density rose rapidly from about 7.65 to upwards of 8.2, and that it still further increased, though slightly, as the temperature fell to 1,000 deg. The density of the chill-cast bar was 8.6, and if we assume this to be the correct, or maximum, density of this alloy, then sand casting leads to an expansion of about 4.6 per cent. It may be added that the alloy is one which shows a moderate expansion when examined with the

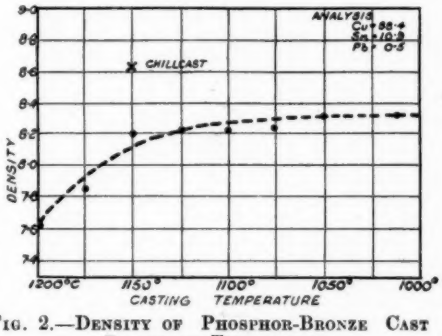


FIG. 2.—DENSITY OF PHOSPHOR-BRONZE CAST AT DIFFERENT TEMPERATURES.

extensometer during the process of cooling in a sand-mould. Brinell hardness tests gave results similar to the density tests.

There is little doubt that the comparative failure, in recent years, to connect the density with the composition and structure of alloys has been due, at least in great measure, to a want of recognition of the difference which exists, in many cases, between slowly- and quickly-cooled alloys.

The general rule appears to be that when there is no crystallisation interval the density is the same whether the metal or alloy is slowly or quickly cooled. But where there is a crystallisation interval (*i.e.*, where the liquidus and solidus are separated) sand-cast bars give a lower density than chill cast, and also show expansions if examined by the extensometer.

Density tests of cast metal are deserving of more attention than they have hitherto received, especially in connection with resistance to pressure of gases and liquids. But it may be pointed out that though the determinations appear to involve very simple operations, there are sources of error which are often overlooked, and that the conditions under which the sample has been prepared must be kept in view. In any case the density of the cold solid only gives the net result of changes, some of which may be negative and others positive in character, while the use of the

extensometer not merely gives the final result, but also permits of the whole of these changes being recorded in order and amount as they occur.

*Causes of Failure.*—Having thus dealt briefly with some of the more fundamental principles which underlie the founder's art, it may be interesting to inquire into some of the chief causes of failure. Men usually prefer to say as little as possible of their failures, and to prepare a lengthy and detailed description of them would be regarded as a waste of time. Hence, though every foundryman knows the causes of many difficulties, there is no tabulated and classified method of keeping records.

In the United States investigations were made and records obtained in reference to the casting of aluminium alloys, and these are the most complete with which I am acquainted. The researches of R. J. Anderson* on "Blowholes, Porosity and Unsoundness of Aluminium Alloy Castings" dealt chiefly with "No. 12" alloy, or copper-aluminium 8: 92. The conclusions reached were that the number of blowholes increased as the pouring temperature was raised, as the temperature in the furnace was raised, and as the length of time taken in melting increased.

The losses in casting aluminium alloys were so considerable that an extensive inquiry into the causes of such losses was instituted. These have recently been examined and classified by R. J. Anderson, who considers them under four general heads: (*a*) Metallurgical Factors, (*b*) Moulding Factors, (*c*) Miscellaneous Factors, and (*d*) Human Element and Labour. These are again subdivided under sixteen sub-heads, and there is little doubt that futher experience would show some difficulty for which no proper class has been provided. The total average casting loss, with a record of 29,220,000 finished castings, was 9.4 per cent. Records of losses with typical aluminium alloy sand castings, at different foundries and including about 100,000 castings, showed a maximum of about 40 per cent. with motor inlet manifold castings, and a minimum of 4.3 with control shaft gear housings. In the former case, the chief trouble was core shifts and core blows, while in the latter it was cracks and broken castings. Certain defects were classified as "allowable," and on these the moulders were not charged. Such defects include cracks, draws, inferior metal, dirty metal, broken on chipping, broken on handling, and core blows. But the moulders were held responsible for the sand and sand holes, core shifts, misruns, wet sand, hard and soft ramming, and sundry other defects of a similar character.

In one large foundry, with a total loss of 13.92 per cent., the chief causes of rejection were:—Due to cores, 2.30 per cent.; due to moulding, 3.22; cracked, 2.27; broken in handling, 1.76; misrun or run out, 2.18; other causes, 2.19.

An examination of such figures shows the absolute necessity of care and skill on the part of the foundry operatives. The man with scientific training can explain the fundamental principles which underlie the industry, and assist in ascertaining and removing the causes of failure. But in the final operations success or failure depends upon the skill, attention, and devotion of the experienced workman, who, as a result of years of training, has acquired a knowledge which he is often unable to express in words, but which it is the desire of every true craftsman to impress upon the product which is the outcome of his labour.

**A LARGE INGOT MOULD.**—The Brightside Foundry & Engineering Company, Limited, Sheffield, have recently made for the Darlington Forge, Limited, a large ingot mould weighing over 87 tons. Although this is not the largest mould they have made—one made in 1911 weighing 98 tons—it is probably the largest casting ever carried by rail. Special trucks had to be constructed by the Great Central Railway Company to carry the mould, which was swung between two wagons on a compound girder weighing over 15 tons, the end of each girder working on a swivel. The mould is over 15 ft. in length, and is octagonal in shape, measuring 9 ft. across the widest point.

## Queries Answered.

**Hydraulic Cylinders.**

K3.—I have seen the answer to one of my queries in the April 28 issue of THE FOUNDRY TRADE JOURNAL, and would like to know if it is possible to have a query as to the names of a few suitable brands of pig-iron for general jobbing work, so that I could advise the buyer. At the moment I have in stock, irons with 5 to 6 per cent. silicon, with 3 to 4 per cent., and one with 1.1 per cent., also some Luxembourg iron of unknown analysis. All break easily, especially the Luxembourg. The high silicon iron is naturally very fragile, but one would expect some strength in the low silicon pig. Could anyone advise me?—"CYLINDER."

K4.—In answer to our correspondent we do not undertake to advise as to the makers of pig-iron. These can be obtained by a perusal of our advertisement columns. Most of the well-known brands are suitable for hydraulic cylinder castings. The kinds of pig-iron which should be mixed to obtain the best results depend very much upon the situation of your correspondent's foundry and the qualities of iron which are most easily and cheaply procurred in his immediate neighbourhood; and as the nominal brands of iron differ considerably in quality in various localities it is difficult to advise him in a short note, because in purchasing the buyer will have to be guided mainly by his experience and the possibilities of obtaining an article as near his requirements as his position affords. Our correspondent appears to be using an iron too high in silicon if his figures are correct. Makers issue tables giving their analysis; a glance over some of these shows the interesting fact that the highest percentage of both silicon and graphitic carbon is found in the same grades of pig-iron, for instance. These tables show that No. 1 grades attain the maximum of 3.30 per cent. silicon, and No. 4 grades attain the minimum of 1.43 per cent. silicon. The proper use of silicon by the careful mixing of different brands of iron will enable the foundryman to produce castings successfully with higher proportions of low grade iron, or if a high proportion of scrap be used castings will be softer and shrink less than if no silicon had been added.

**Foundry Doors.**

L1.—The end wall of our foundry has been knocked out to allow the electric crane to pass into the yard. Below the crane, the walls remain with double doors to allow the charge suspended to pass, but to close the space above—measuring 40 ft. by 10 ft.—is a difficulty. Two half-doors each 20 ft. by 10 ft. are not easily arranged, as these would be "whippy" unless exceptionally well braced, but the chief difficulty is that the continuation of the building which forms the crane runway, would not admit a swing door to lie sufficiently close to it (when open) to allow the crane to pass. I have heard of a building having a movable end panel mounted on wheels which the crane pushes in front of it, leaves at the end of the rails, while working outside, and fetches back to close the gap when outside work is finished. If any readers can give me a dimensioned sketch of a satisfactory door I should be very grateful.—"VOYAGEUR."

**Acid Resisting Bronze.**

M. I.—We have of late received inquiries for castings of valve seats for pumps to be made from acid-resisting bronze. Would someone please inform me if such a bronze actually exists, and, is so, what the composition is?—"MOULDER."

D1. What is the cause of the "break" on the surface of molten cast iron, and why is it so very animated on some classes of iron, and hardly perceptible on others?

E1. Does iron get hotter when kept in the cupola bottom?

F1. If a cupola is ready for blowing, that is, the bed burned through and the furnace filled up, and a fault develops in the power or in the blower, how long is it safe to leave the furnace standing, and what precautions are necessary?

G1. Which should require the higher coke consumption in cupola melting, grey iron or malleable iron?

J1. What is the correct ratio of tuyere area to diameter of cupola for the most efficient melting?

# Institution of British Foundrymen.

## LANCASHIRE BRANCH.

The annual meeting of the Lancashire Branch was held on May 7 at the Manchester College of Technology, Mr. W. H. Meadowcroft in the chair. The President of the Institution, Mr. Matt Riddell, was present, and addressed the meeting on the subject of the education of the foundryman, pointing out the advantages of the Institution as an educational force.

THE BRANCH-PRESIDENT said he regretted there was not a greater number present, but the attendance was affected by the industrial troubles. He was sure the address would do a great deal of good. There was a danger of becoming immersed in details, and it was a good thing that occasionally, gentlemen, like Mr. Riddell, should direct attention to the wider aspects of subjects of general importance. He agreed with a good deal of what had been said about education. They would have to revive the spirit which was displayed while the war was on, when everybody realised that there was work for him to do, and he must do it to the best of his ability.

THE SECRETARY (Mr. Hogg), in presenting the annual report and balance-sheet, explained superficially, the Branch did not appear to have made the progress which they were accustomed to seeing year after year, but it must be borne in mind that there were two classes of members. Some whose names appeared on the list took little or no interest in the work of the Institution, but others were really earnest and active. In that respect there was no falling off. The actual members upon the roll were:—Members, 80; Associate members, 131; Associates, 5; total, 218. Last year the numbers were respectively 81, 134 and 11, and the total 226. Twelve Council meetings had been held, the average attendance being 11. At the general meetings, eight in number, attended by 510 members. A varied programme of lectures was submitted, and the Council also arranged visits to the works of several firms. The members responded very well, and it was hoped to arrange other visits during the summer. The income of the Branch received from the parent body was £30, to which was added the balance of £6 9s. brought forward from the previous year. The expenditure amounted to £27 17s. 8d., and the balance now in hand was £8 11s. 4d.. £147 5s. received for subscriptions had been forwarded to the General Secretary.

MR. HOGG added that the General Council had considered a scheme whereby more money would be devoted to Branch purposes. It had been a difficult time for the General Council, and now that the subscription had been increased it would be possible to do more to make the Institution better known and appreciated.

The report and balance-sheet were passed. A vote of thanks to the officers was passed unanimously on the motion of Mr. Makinson, seconded by Mr. Greenwood.

MR. SIMKISS proposed that Mr. W. H. Meadowcroft be re-elected President for the coming year. He pointed out that the experience of the past twelve months enabled them to judge of Mr. Meadowcroft's capacity as President, and that the results of the next year should be even more gratifying. The motion was seconded by Mr. Roe, and passed unanimously. The other retiring officers were re-elected *en bloc* as follows:—Senior vice-president, Mr. J. Haigh; junior vice-president, Mr. R. A. Miles; secretary, Mr. J. Hogg; auditors, Messrs. J. Nicholls and R. P. Layfield; representatives to the Council, Messrs. S. Roe, H. Sherburn, J. Haigh, A. L. Key. The vacancies on the Branch Council were filled by the election of Messrs. W. H. Cook, G. Barnes, A. Hill, and S. Langton.

The following paper was read by the Secretary.

### "Some Experiences with Core Sands," by Mr. T. G. Hilton.

The intention of this Paper is to give a short summary of the various kinds of sand mixtures, using the cheaper and commoner varieties of core binders, such as flour, resin, oil, gum, etc., as apart from the various commercial compounds now sold by foundry supply firms. These latter, which comprise such compounds as Glutrin, Fax, Spermoline, Stearine, and others, the author has had some little experience, but not sufficient as yet, on which to pass a fair opinion.

The following sand mixtures, of which the correct proportions are given, are the result of experience in making cores for jobbing work, and do not apply to places where a uniform standard mixture is sufficient, such as in motor works, etc.

*Linseed Oil Mixtures.*—Sea or river sand with linseed oil as binder is recognised as one of the finest of core sand mixtures for most classes of light or medium work, but owing to the high cost of the oil, particularly as from the beginning of the late war, it is seldom used in small foundries. This mixture was regularly used for years by the author in making cores of an exceptional character, mainly of a light nature, where venting presented difficulties and cheap binders could not be relied upon to give so strong a core. The proportions used were 1 part of oil to 40 parts of sea sand for light cores, up to 1 part oil to 20 parts sand for medium work.

This oil mixture is unsuitable for cores of a large character, or where a bulk of metal is liable to be near them, as the great heat of the liquid metal will have a tendency to burn out the oil-binder long before the casting is properly set, and will allow the sand to crumble away.

An undoubted disadvantage in using linseed-oil sand mixtures on a large scale is the amount of noxious fumes which are generated and hang about the shop, causing much unpleasantness to the workmen.

Again, cores that have to withstand a flow of metal are seldom satisfactory when made with an oil sand mixture. Take, for instance, the 6-in. trench mortar bomb made during the war. The cutting action of the metal with being forced through an $\frac{1}{8}$-in. spray runner burned out the oil binder at that particular part, and was the cause of thousands of bombs being scrapped through scab. If a different method of running these bombs had been permissible, for example, from either top or bottom of the mould so that the metal could have run alongside the core instead of impinging against it, then the use of linseed oil and the commercial compounds, such as Glutrin, etc., would have been justified.

The author, in dealing with this problem, reverted to a mixing of ordinary green core sand, namely, 4 parts of red sand, 7 parts of floor sand, and 2 parts of manure, when the trouble was practically at an end so far as scabbing was concerned.

*Flour Mixtures.*—Flour is another binder that has its own particular use, one of which is the making of name-plate cores. The mixture used was 1 part of flour to 16 parts of ground red sand, and the method employed was to place a layer of flour-sand over the letters in the corebox and then fill up with ordinary green-core-sand. After drying, alternatively a little dry plumbago was dusted on, or wet plumbago was sprayed over the surface as the cores had to peel from the castings, leaving the letters as perfect as possible.

Another use for this sand is in the making of fluted cores, such as are used for the making of joints on castings to withstand steam or hydraulic pressure. Care must be taken when mixing this sand (as in all other mixtures) to make sure that the binder is well distributed throughout the mass of sand, and that no more of the flour is used than is necessary for the mixture, otherwise the cores are liable to swell and crack during drying in the oven.

A flour binder is unsuitable for making cores which have to remain in the mould for any length of time, as they absorb moisture very rapidly and begin to grow. A furry or fungoid growth appears all over the surface of the cores, and tends to cause blowing during casting.

When flour sand has to be used for cores that may possibly have stood for a day or two in the mould before casting it is advisable to mix a little linseed oil with it, and this forms a good strong core that will largely resist dampness.

*Resin.*—This binder, though not used to the same extent as before the introduction of the

patent core compounds, which, by the way, very often contain more or less resin, nevertheless is a very useful help to the core-maker, as cores made with its aid are strong, damp-proof, and vent freely. The mixture recommended by the author is 1 part of powdered resin to 20 parts of ground red sand for small cores, up to 1 part of resin to 12 parts of sand for medium work.

Cores made out of this mixture need to be dried in a fairly quick oven, and allowed to cool before handling, as the resin has a tendency to keep the sand mixture soft until cool.

*Core Gum.*—This binder, though really coming under the head of commercial compounds, is included in the list, as it can be regarded as the binder *par excellence* for cores for small jobbing work, mainly owing to its cheapness, if used discriminately, and the ease with which it can be employed. No particular class of sand is necessary when this binder is used; red, yellow, and floor sand being equally suitable and satisfactory. Whichever sand is used, it should be ground before mixing, as by doing so a closer-grained core is obtained which leaves a cleaner face on the resulting casting.

Although gum is distinctly inferior to oil and sea sand for making cores that are practically self-venting, yet if used in cores where the vents can be brought off easily by means of a vent wire, it will powder away and leave the castings as clean as if the cores had been blacked with plumbago. The sand advocated for these cores is mainly floor sand, preferably from the plate-moulders' floor, as this possesses a certain amount of cohesiveness, owing to its not being burnt to the same extent as ordinary floor sand. The sand is mixed in the proportion of a handful of gum to a riddleful of sand.

For better-class work a mixture of ground sand as supplied to plate-moulders for facing their patterns and consisting of 7 parts floor sand, 1½ parts red sand, and ½ part of coal dust, with the gum added in the same proportion as before, will be found to give results equal, if not superior, to many of the oil binders, leaving the castings with that blueish tint, so expressive of a good finish, without the aid of plumbago or other heat-resisting substance.

*Claywash.*—Many coremakers adopt the practice of binding sands used for large cores with claywash, but this is a very unsatisfactory binder because, if the claywash is rather thick, there is a probability of choking up any venting properties the sand may possess, and, if too thin, there is the risk of the hot metal eating its way into the cores, resulting in scabbed castings. When experimenting with this binder it was ascertained that the correct strength is such that when the finger is put into the liquid a thin coating of clay adheres.

The author's recipe for large cores is 5 parts red sand, 7 parts black sand, and 2 parts of manure ground to the correct consistency with water. Ram the cores fairly hard, vent freely, and a good result is assured.

*Loam Sand:*—Another mixture of sand which possesses little binding matter with the exception of manure and water, is loam sand. Many years ago some considerable trouble was experienced with cores for a number of press castings, which varied in weight from ¼ cwt. to 4 tons. In the smaller ones, which were about 2 ft. square by 4 in. deep, a difficulty was encountered in sufficiently strengthening the cores with core-irons, and also in bringing off the vents, owing to their peculiar formation, having several little pillars connecting the top and bottom plates. There was but two small holes on two sides of the castings through which to bring the vents and also the sand irons—when cast.

Several mixings were tried with various degrees of success, but ultimately a mixture of 6 parts red sand, 4 parts black sand, and 2½ parts of manure was decided upon. This was ground to a stiff loam and stoved. After which it was powdered and mixed with water to form a workable mixture. These cores proved quite satisfactory, requiring little strengthening, making a good hard surface, and yet porous enough to bring off the vents.

Some time later the manufacture of water-jacketed twin-cylinder pumps was taken up, and as the cores for the water jacket and ports were similar to the press cores as regards difficult venting and the little chance of proper ironing, the mixing of loam sand was again resorted to, and was so successful that the same mixing is in use for the same class of work at the present time.

Recently a similar mixing to the above was resorted to in the making of castings for porcelain mill bottoms, but when these castings were ordered a core iron pattern was sent along with the instructions to use oil-sand for making the core, mainly to facilitate the easy removal of the core and iron after being cast. The mixture used was 1 part of linseed oil to 16 parts of river sand. After casting one it was found that the heat from the large body of metal was burning out the binder, causing the sand to become friable long before the metal was set. The vents also were acting in a very erratic manner by first blowing off furiously and then becoming choked up.

Permission having been obtained, the core-iron pattern was altered and loam sand tried in preference to oil-sand, and by doing so a core was produced that was easy to handle, clear vented, and which, when cast, was quite as easy to break out as any oil-sand core. This sand was afterwards used for the rest of the cores in the order, and was entirely satisfactory.

As the successful use of any core binder depends mainly on its thorough distribution throughout the body of sand used, it may be useful if the method adopted for that purpose is outlined.

The sand is brought from the grinding mill and put through as fine a riddle as is convenient, the binder is then added in the correct proportion, and the whole mixed together with the hands. It is then damped to a working consistency, put through a ¼-in. riddle, and, after another turn or two with the hands, the sand is quite ready for use.

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## NEWCASTLE BRANCH.

### The Surtees Memorial.

At a meeting held on April 30, Mr. George Vardy, M.B.E., Branch President in the chair, an open discussion took place as there was no set paper on the agenda, and advantage was taken of the occasion to explain the latest position with regard to the John Surtees' Memorial, the originator of which is Mr. Mayer, of Dumbarton.

At the outset the CHAIRMAN announced thirteen new members, making a total of sixty-four since the beginning of the session. The total membership of the Branch was now over 200, which made them third on the list as regards membership.

MR. J. D. CARMICHAEL said he would like to make a short statement with reference to the Surtees' Memorial scheme, which was now practically complete. A year or two ago they made an attempt to get Mr. Mayer's scheme carried out by appealing to the members of the Association and to individual subscribers, but owing to the war and other circumstances it had been prevented maturing. Mr. Mayer and he had gone thoroughly into the matter, and he (Mr. Carmichael) believed that a thoroughly good scheme had now been formulated.

MR. CARMICHAEL proceeded to read a long communication, from which it appeared that the necessary funds had now been invested for the provision of gold and silver medals for competition annually, and it had been arranged that the Governors of the Royal Technical College, Glasgow, should undertake the custody of the title deeds. It was hoped that the competition would be commenced in Newcastle next session, and afterwards held alternately in Glasgow and Newcastle, the competition being confined to these two branches. The competitors must be members of the Newcastle or Glasgow Branches, according to the district in which they were working at the time of the competition. The awarding of the medals would be left in the hands of past presidents and the president of the respective Branches. The medals were left plain around the outer rim so that they could be engraved with the names of the winners. No money prizes would be given, and the whole idea of the memorial was to commemorate the name of one who did so much for the improvement of foundry practice and to

encourage lads who were being trained to greater attainments and success in the craft.

Mr. Carmichael stated that Mr. Mayer himself was "thrown into the foundry" when he was nine years of age, and in his letter to Mr. Carmichael he said that if he had the chance of beginning all over again he would again elect to be a moulder, because it was a fine art. He also expressed the hope that the lads who were now going into the trade would be much better educated than in any other branch of the engineering trade. Mr. Mayer's idea is to give boys and men now in the foundries a much better chance than formerly. Yet we all know that he has made the most of his opportunities, as is indicated by the position which he now holds and by the mark which he has left on his art. He is determined to make things easier and better for foundry youths, believing as he does that the foundry trade is the most important part of the engineering industry.

The Memorial is to be governed by a committee of past presidents, who could make any conditions they liked as to the form of the examination, for they were not restricted in any way. The invested funds would yield sufficient in perpetuity to provide gold and silver medals from a die specially designed, and the residue from the fund would be used for the purchase of books and instruments, and presented to authors of papers or essays as the trustees may determine. Competitors must have been members or associates of the respective branches for not less than twelve months at the time of the examination, except in the junior class, for which that condition may be suspended at the discretion of the Governors. There would be two grades in competition—the senior, composed of members and associates who had served a regular apprenticeship in a foundry and who were engaged as moulders or officials in a foundry; and the junior section, open to associates who were apprentice moulders. The examinations might be either *viva voce*, written, or in any other manner subject to the object of the Memorial, namely, the propagation and advancement of knowledge for the production of castings. The winner of the gold medal shall be ineligible to be awarded a further gold medal, but may be awarded one of the auxiliary prizes as the Governors may direct. The winner of the silver medal shall also be ineligible to be awarded a further silver medal, but may be awarded an auxiliary prize, and when qualified to enter the senior class would be entitled to participate in all its privileges, including the securing of the gold medal. In conclusion, Mr. Carmichael expressed the opinion that they must get the boys interested before they set the subjects, and it was suggested that the competitions should be made easy and simple so as to suit apprentice moulders. In the past they had been a neglected class, for they had not had the same opportunities or the same encouragements as the engineers, the patternmakers or the chemists, and they must set subjects to suit both the boys and the men.

The President said they were very much obliged to Mr. Carmichael for the interest he had taken in the Memorial, and they were deeply indebted to Mr. Mayer for his generosity in regard to that scheme. He trusted that Newcastle would do well at the first examinations, and that they would have a very good competition.

The meeting was then thrown open for the discussion of impromptu questions, one of which was: In what respect may British foundry methods be improved, and are engineers justified in saying that foundrymen are behind the times?

Mr. Lillie expressed the opinion that a great deal of the fault of many foundries to-day was that they had an engineer manager instead of a foundry manager.

Mr. W. J. Paulin (an engineer) said he had nothing to do with the framing of the questions, but he must point out that most of the foundries that had made any advance at all had been attached to engineering works. Invariably the advance made in the engineering section had been reflected in the foundry section, and the higher level to which the engineering section had been brought under the skilful management of the engineer had been a sort of standard to which he desired to bring the foundry section. He thought it was hardly fair to assume that an engineer who realised the advantages of better conditions in the engineering section was going to be blind to the advantage of the same conditions in the foundry. There was not the slightest doubt that the moulders had benefited from their association with the engineers.

Mr. R. O. Patterson thought the two questions must be flung together. The improvement that could be made in a foundry depended entirely upon the engineer. It was due to the engineer's conservatism in not changing his own design that the foundry had been so much kept in the background by having to make new tackle for every job that came along. He thought a big improvement would be made from the standardisation of castings in the future. Another thing was that in the past the engineer had ground the foundry down in the matter of price, and, as a consequence, the foundries could not afford to put improvements into their works. They never saw a foundry with an adequate staff of men, and it was always a tumble-down, dirty hole—even in the office. In the States they were ahead of us in their machine methods, but in regard to jobbing work we were streets ahead of them, and we did jobs which they would not even know how to commence.

Mr. Lillie said he had been on the Continent, and he contended that there they were far ahead of foundrymen in this country. There the apprentices were under a master, and until he was thoroughly educated the apprentice was never allowed into the main foundry. By that means they turned out the best men, because every boy had the natural ambition to get into the foundry, and until he made himself efficient there was no chance of getting there. In this country they did not make the work sufficiently attractive.

Our boys had not the inclination to go to classes, but that would have to be altered if they were going to do anything in the future, and he did not think they could do better than to follow the French system.

Mr. Matthew Gallon said that with regard to the engineer being placed in the position of manager of a foundry that was their own fault. If they thought themselves worthy of being foundrymen they ought to be able to manage their own foundries. If an engineer could come and take their place as managers he said it was a disgrace to themselves. It was necessary they should go ahead and be able to manage their own works, and should start right straightaway. If they had not done well in the past then he maintained that the best thing to do was to go back and begin over again, and in five or ten years' time he would undertake to say there would not be an engineer-manager in a foundry.

Mr. H. J. Young maintained that an engineer or a chemist could not efficiently control the work and output of a foundry, because it took a lifetime to become efficient as an engineer, a chemist, or a foundry manager. Educated foundry managers were an absolute necessity; they might know engineering, but their job was foundry work.

The foundry trade appeared to be behind the times for the reason that the foundryman had always been regarded as the bottom dog, and only to-day are there signs of a change. He thought the average skilled moulder should get more money than the average skilled mechanic; skill for skill, it was obviously more difficult work, and generally done under more trying conditions. His opinion of improving foundry-work would be to give better pay and to get better men.

## Aluminium Solders.

American patent No. 1,321,529, granted to J. C. Kelly, protects the following composition: Lead, 34.7; tin, 34.7; and zinc, 30.6 per cent. The flux used with this is the subject of a further patent, and contains stearic acid, 50.0; mutton tallow, 43.75; and skunk oil, 6.25 per cent. Another mixture, patented by J. Salen, consists of the following: Tin, 64.25; aluminium, 14.0; and zinc, 21.25 per cent.

# Trade Talk.

The Birmingham office of Messrs. Lewis Lazarus & Sons has been removed to Empire House, 159, Great Charles Street, Birmingham.

Mr. A. W. Bainbridge, 63, Queen Victoria Street, London, E.C.4, has been appointed British agent for Les Forges de Clabecq, Belgium.

The result of the second ballot for the office of district secretary of the A.E.U. at Sheffield is as follows:—R. E. Jones, 1,205; J. Bonnett, 1,069.

Mr. H. E. Lance Martin, B.Sc., read a Paper on "Screw-Threads and their Errors," in the Armstrong College, Newcastle, under the auspices of the Applied Science Section.

The work of converting a number of the boilers at Dunston electric power station to burn oil fuel has been entrusted to Messrs. Hawthorn, Leslie & Company, Limited, St. Peters.

At a meeting of the Tyne Improvement Commission in Newcastle it was reported that there were 244 vessels of 273,302 total net register tons laid up in the Tyne at the end of April.

The "Labour Gazette" states that 98 trade disputes involving stoppages were in progress during the whole or some part of April, and estimates the aggregate duration at 24,000,000 working days.

The removal of the offices of the Institution of Electrical Engineers to its own building has been completed, and in future all communications should be sent to Savoy Place, Victoria Embankment, W.C.2.

The Wallsend Slipway and Engineering Company, of Wallsend-on-Tyne, have issued a finely produced and illustrated brochure as "A 50 Years' Retrospect" of the work of their firm, which was founded in 1871.

All electricians, with the exception of a few who are not members of the union affected, have absented from the Tyneside shipyards, but work proceeded as usual, with the assistance of apprentices, and in some cases the officials.

A further 1,000 men have been thrown idle at Stockton by the closing of Messrs. Blair & Company's marine engineering works owing to the coal shortage. This is the first of the local engineering works to come to a standstill.

Belfast District Committee of the Engineering and Shipbuilding Federation have agreed to the proposal of the employers for a reduction of 6s. per week on time wages and 15 per cent. on piece rates, to become operative in two moieties.

It is reported that the Victorian Electricity Commission has accepted a single American tender of £379,000 for switch gear and transformers. This represents a saving of £200,000 on a combination of sectional tenders by various British firms.

Nearly 1,500 applications for membership of the proposed Engineers' Club are reported to have been received, and these are being added to daily. Applications are coming not only from London and the provinces, but from all parts of the world.

A Greaves-Etchells electric furnace of half-ton capacity has recently been put into operation at the works of A. Hamilton & Sons, Limited, Bute Docks, Cardiff, for the production of steel castings. This is the first electric furnace to be installed in Wales.

Messrs. Sutherlands, Limited, of Belfast, have installed, and will shortly put into operation, a 30-cwt. electric furnace of the electro-metal type. This is the first electric furnace to be installed in Ireland, and will melt steel for small and medium weight castings.

The 73rd annual meeting of the Association of Trade Protection Societies of the United Kingdom was opened in London last week. Mr. Walter Runciman, the president, was in the chair. The proceedings, which were private, consisted of discussions on matters connected with organisation.

At the annual conference of the National Chamber of Trade, which will be held at Cheltenham from May 21 to 25, the Parliamentary and Executive Committee will submit resolutions dealing with national economy and the payment of bonuses to Government employés under 21 years of age.

About 1,500 members in South Wales and Monmouthshire are affected by the strike in connection with the Electrical Trades Union. The men, by a ballot vote, decided against the proposed reduction of 10 per cent. in wages in two "cuts" of 5 per cent. on May 9 and July 11 respectively.

The membership of the North-Eastern Centre of the Institution of Electrical Engineers has been increased during the past session from 396 to 434. This was the statement given in the annual report submitted by Mr. H. B. Poynder at the annual meeting held in the Armstrong College, Newcastle. Mr. J. R. Beard presided.

A commission appointed by the International Labour Office, of which M. Oudegeest, Secretary of the International Federation of Trade Unions, is chairman, has been studying the question of uniformity in unemployment statistics, and its proposals have recently been approved by the Governing body of the International Labour Office.

An earnest desire is stated to prevail for a trade union organisation which will cater for all skilled and semi-skilled workers engaged in the engineering industry. Shop stewards and local officials of the A.E.U., it is stated, are being urged to make efforts with members of other organisations with a view to further action.

The directors of Siemens Brothers & Company, Limited, propose to increase the authorised capital by the creation of 1,000,000 10 per cent. £1 cumulative preference shares and to issue 300,000 of the same to all the existing shareholders by way of bonus, in the proportion of one fully-paid preference share for every five shares held.

At the annual general meeting of the Institution of Civil Engineers, the result of the ballot for the election of officers for the year 1921-1922 was declared as follows:—President, Mr. W. B. Worthington (London); vice-presidents, Mr. W. H. Maw (London), Mr. Charles L. Morgan (London), Mr. Basil Mott (London), and Sir William H. Ellis (Sheffield).

The boilermakers, shipwrights, and blacksmiths employed in Leith shipyards who came out on strike against a reduction of 3s. per week for time workers and 7½ per cent. for piece workers, having held meetings with their Executive Committee, have accepted the reduced rates and returned to work. Short time is being worked in all the yards.

The directors of Vickers, Limited, state that while the books for 1920 are practically complete as far as ordinary transactions are concerned, there are still outstanding questions with Government Departments of such importance that they regret it is not possible yet to present final accounts for the year, or even to state definitely when that will be done.

At the annual conference of the Association of Teachers in Technical Institutions, held at Cardiff, a resolution was submitted urging "the necessity of the immediate appointment of a Royal Commission, or the institution of other suitable body, to investigate the whole field of technical education in its relation to the great problem of national reconstruction."

His Majesty's Consul at Helsingfors (Mr. C. H. Mackie) reports that the Central Administration of the Finland State Railways is inviting tenders for the supply of 5,000 tons of steel rails, 220 tons of fishplates, 650 tons of soleplates. Sealed tenders, marked "Anbud a Raler," must be handed in to the Registry of the Railway Board not later than June 21 next.

Owing to the continually increasing business, the firm of Stanbrook & Mundle, trading as the Northern Brass Foundry Company, Glasshouse Lane, East Street, Gateshead, is being formed into a limited liability company under the style of the Electric Locomotion & Foundry Company, Limited, of Globe Chambers, 19, Side, Newcastle-upon-Tyne, where all future communications should be addressed.

The Federation of British Industries has received information to the effect that a decree has appeared in the official "Italian Gazette" of May 2 exempting from customs duties all ships' materials, machinery, boilers, and auxiliary apparatus sent into Italy for the completion of ships under construction in the Adriatic ports of the Veneto district, which were begun between November 3, 1918, and October 31, 1920.

An unofficial conference of the secretaries of the engineering standardising organisations in various countries has been held in London. The conference, which lasted four days, was convened by the secretary of the British Engineering Standards Association, and was opened by the chairman of the association, Sir Archibald Denny. The object of the conference was the exchange of ideas looking towards the establishment of closer relationship.

At a recent meeting of the Stamped or Pressed Metal Wares Trade Board (Great Britain), it was decided to fix special general minimum time rates, piece-work basis time rates, and overtime rates for certain special classes of female workers, and piece-work basis time rates for male workers. Notification of the minimum rates as fixed by the Trade Board has been sent to the Minister of Labour, with a request that he should make an order confirming them and making them operative as from June 6.

Captain U. de B. Charles, Commercial Secretary to His Majesty's Embassy at Madrid, has arrived in this country on a short official visit, and will be pleased to meet manufacturers and merchants who wish to consult him in regard to steps to be taken for opening up trade with Spain and who desire information as to the state of trade in that country. Firms desirous of making appointments to interview Captain Charles in London up to June 3 should communicate immediately with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, quoting the reference 3055 T.C.

# IRON AND STEEL MARKETS.

## Pig-Iron.

With production of the metal virtually suspended for an indefinite period, very little interest is taken in market movements of pig-iron, and consequently the intervention of the Whitsun holidays has had no perceptible effect on the course of business. The position of the trade is, in fact, in a hopelessly unsatisfactory condition, and whether for home consumption or for export abroad, the prospect of an early return to activity may be regarded as distinctly improbable. Smelting operations having practically ceased for the time being, the few consumers still requiring iron are entirely dependent upon the stock resources in makers' yards, and though these are said to be fairly plentiful as concerns the lower qualities of pig, supplies of No. 3 foundry pig must now be almost exhausted. The Board of Trade returns for April disclose a further heavy increase in pig-iron imports, mostly from European sources, the figures showing the substantial total of 23,926 tons, as compared with 1,407 tons in the corresponding period for 1920, while exports of this metal amounted to an aggregate of 11,048 tons only. The Cleveland iron market having been suspended during Whit-Week, business has remained at a standstill, and although a few small parcels of foundry iron have changed hands of late, it is understood that sales have only been effected on the basis of a 10s. premium above the official minimum prices. As, however, Midland makers are stated to be asking £1 per ton more than their recent quotations, and Scotch foundry iron is very firm at 165s. to 170s., Cleveland still supplies the cheapest iron, and no difficulty is anticipated in realising the higher prices now asked for foundry qualities. Makers still hold heavy stocks of forge, mottled and white iron, and would be glad to realise at the official prices, even though these are well below the actual cost of production. Quotations continue firm as follow: No. 1, 125s. per ton; No. 3 Cleveland G.M.B., 120s.; No. 4 foundry, 119s.; No. 4 forge and mottled, 117s. 6d.; white, 115s. per ton, but all foundry qualities realise 10s. more than these prices. As evidencing the very serious condition of affairs in the smelting industry at present, the announcement is made that at the Consett Iron Company's works, owing to the failure of coke supplies, the one blast furnace in operation is to be damped down. Two or three of the other furnaces which have been damped down have suffered so much injury that they have been blown out and will not be started again. The other blast furnaces will also probably be blown out permanently. In the Manchester district, foundry iron is no longer plentiful, and buyers have to pay a little more if they want any; but, as a rule, consumers are unable to go on for lack of fuel. With regard to other qualities of pig-iron, there has been very little consumption during the last month, and as a consequence the stocks of these remaining to be sold are large.

East Coast hematite is in very poor demand, and even at the reduced price of 160s. per ton mixed numbers are not easily saleable. Some makers are prepared to sell for export at 150s., whilst others quote 2s. 6d. per ton more. In West Cumberland and North Lancashire hematite pig-iron makers are without any orders on their books, and they see no prospect of securing any at the price at which iron is quoted, namely, £9 per ton. A coal settlement which does not give coal to the furnaces at less than 20s. per ton will be of no use whatever to ironmasters.

## Steel.

The usual holiday interruption has had very little influence on this occasion on the steel trade position, industrial inactivity continuing unabated in intensity, with perhaps the exception of some finishing branches still fairly well provided with orders, and having electric power at their disposal. Pending the renewal of ample fuel supplies, production of such Sheffield specialities as farm, field, garden and building tools and appliances, for which there is a fairly good home demand, is still at a standstill, while inquiries for steel for export are on a more satisfactory scale than has been experienced of late. As evidenced from the latest Board of Trade returns there is also a revived and growing demand for machinery and electrical plants and appliances, which should provide a considerable amount of work for manufacturers of these lines, but how soon this may occur must, of course, be entirely dependent on an early resumption of the coal industry. Taken altogether, members of the steel trade are quite justified in an optimistic view of the outlook, and given a satisfactory settlement of the miners' trouble there is no occasion to dissent from that attitude. In the meantime, the trend of steel prices is steadily progressing in a downward direction, finished steel bars in the West Midlands declining last week 10s. or more per ton to £13, as compared with £13 10s. to £14 10s. previously. Continental prices decline at an even faster rate, and Belgian bars, it is reported, can now be bought at £11 delivered here. On the West of Scotland conditions remain unchanged. All the steel works are still closed, and are not likely to resume until the coal strike is definitely settled. Fresh business is extremely scarce, shipbuilding being still very quiet on Clydeside, and no new orders of any description have lately been placed. Prices remain unchanged, but, doubtless, if the mills had been rolling there would have been reductions. The steel sheet branch is very quiet, most of the mills being closed down. There is no change to report in prices. The export trade still shows no signs of any improvement, and this is not anticipated until labour and other conditions are improved. With the almost compulsory stoppage of manufacturing industries, the market for semi-products is at a complete standstill, and until consumption at works is renewed no change in the existing position is either probable or anticipated.

## Finished Iron.

Markets for this class of material are absolutely stagnant at the moment, and, as far as can be ascertained, the majority of makers are at present availing themselves of the idle interval for the execution of the necessary repairs and renewals of plants in preparation for restarting when fuel supplies are once more assured. During the past two months of the miners' dispute manufacturers' stocks have been largely depleted to meet contracts and any current orders coming forward, and although buying has been by no means brisk, there can be very little material available to meet even a moderate demand. Rolling at the bar mills has been practically suspended since the holidays commenced, and only a very few works in the Midlands are in a position to undertake any considerable volume of business until colliery outputs are resumed. Forward buying meantime is almost out of the question, and orders now placed are only in just sufficient quantities to fulfil immediate requirements. It is now quite expected in trade circles that marked bars will be reduced when business recommences, and in the general opinion such a movement is somewhat overdue, the present basis of £27 10s. being regarded as out of all proportion to the £19 asked for second-class bars. Demand for bar iron was sustained right up to the outbreak of the miners' strike, and works extensions now in progress are in preparation for a larger output later on. Second-class iron is in very moderate demand, and makers are willing to dispose of stocks at current rates rather than hold them on the possibility of some recovery in prices when buying is resumed on a normal scale. Strip makers have disposed of their stocks, and the few tube works still in operation are mainly running on strip obtained from the Continent. Recently both French and Belgian products have stiffened in sympathy with the appreciation of the franc, though they are still substantially below English prices. The imports of iron, steel, etc., at Hull from abroad during the past week were:—Iron: Pig, 50 tons (Ellerman's Wilson Line); bar, 22 tons (Wilson's and N.E.R. Company); rods, 6 tons (Ellerman's Wilson Line). Steel: 55 tons (Furley & Company), 20 tons (Goole and Sheffield Transport Company), 20 tons (Wilson's and N.E.R. Company), 10 tons (Gerhard & Hey), 6½ tons (Gardiner, Barugh & Jones). Aluminium: Ingots, 12½ tons (S. Jones & Company). Spelter: 100 tons (H. Gardiner & Company). Goole.—Iron: Pig, 20 tons, 4,892 bars; steel, 825 billets, 6,385 bars, 634 plates, 1,436 sheets, 72 beams, 172 joists (order).

## Scrap.

The prolonged suspension of fuel supplies, in conjunction with holiday interruptions, have brought an almost entire cessation of business in the scrap metal trade, which at the moment is in a state of utter stagnation. The majority of consumers of this class of material, especially foundrymen, have fairly heavy stocks in hand, or have bought largely forward at the inflated prices ruling a short time ago, and in many cases are compelled to postpone deliveries on the ground of lack of accommodation for further stocks of metals. In the Lancashire district the market continues idle, most qualities of scrap failing to elicit any response from buyers when offered, while prices in all grades are irregular and mostly nominal. Heavy wrought scrap is now reported quoted as low as £3 per ton, while about the same figure is all that can be obtained for steel. In South Wales, heavy steel scrap is on offer at 55s. to 70s., with odd parcels of bundled steel and shearings at 50s. to 60s. and turnings at about 50s. Heavy cast iron in large pieces and furnace sizes is in poor demand and is obtainable at from 60s. to 100s.

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## Tinplates.

Very little change can be recorded in the conditions of the tinplate trade, most of the business done being confined to stock lots at prices ruling from 26s. to 26s. 6d. net cash f.o.t. at works. Shipments for last week were on a decreased scale, amounting to only 23,464 boxes, as compared with nearly 40,000 in the previous week. A few inquiries on forward account have been received by makers, but in the circumstances now obtaining quotations take a somewhat wide range from 26s. to 30s. The majority of the Welsh mills are, of course idle, except in some finishing departments, the total suspension of the coal industry having had a disastrous effect upon this branch of trade. Wasters are in moderate demand. Prices are hardening; C.W. 14 x 20 are scarce at 21s. 6d.; C.W. 28 x 20 firm at 40s. per box; and C.W. 14 x 18¾ are worth 20s. upwards. Terneplates are nominally 27s. basis, very little business being reported.

In the States, tinplate specifications are coming to independent companies and the Steel Corporation from scattered points. The American Sheet and Tinplate Company reports some fairly sizable business received recently, the tonnage being larger than of late. Additional business is in sight. Most of the business is coming from canners. Pacific Coast packers who some weeks ago estimated a pack of 40 per cent. of normal have increased their figure. They now expect a normal pack of fruits and vegetables. This outlook for tinplate is encouraging. Other industries, including coffee, tobacco, paints and pharmaceuticals, require tinplate. The leading interest not only has increased its operating schedule, particularly at Farrell, Pa., but from time to time will put on additional mills at other plants. Some of the independent producers report a quickening demand for stock plates in lots of two to three cars. This tinplate is sold at 50 cents per base box under the price of production plate, namely, $6.25 or $5.75 per base box, Pittsburgh

## Metals.

**Copper.**—Dealings in the copper market developed increased activity at the close of last week, with a well-sustained tendency to a higher price basis, values having appreciated £2 2s. 6d. to £2 17s. 6d. a ton, while the backwardation on three months' delivery was reduced from 20s. to 5s. a ton. Rough bar metal is still under close control, but the stringency in cash and near delivery has been counteracted by fair supplies of refined qualities, chiefly English, being delivered as "standard." In the States, as a result of the increased domestic and foreign demand, prices are fractionally higher on all positions, a considerable business being done with home consumers of electrolytic at 12¾ cents for prompt, May and June shipment. All of the large producers are holding at this latter price, and few of them now would consider even 13¼ cents delivered for July shipment. For the full third quarter, buyers are asking 13¼ to 13⅜ cents delivered. The week's markets here opened with somewhat less activity, but quotations were firm, and a good inquiry was reported. Closing prices:—Cash: Wednesday, £74 10s.; Thursday, £74 17s. 6d.; Friday, £75 5s.; Monday, £75 10s.; Tuesday, £74. Three months: Wednesday, £73 15s.; Thursday, £74 7s. 6d.; Friday, £75; Monday, £75 12s. 6d.; Tuesday, £74.

**Tin.**—During the past week the market for this metal was dominated by influential interests, quotations closing at the best, marking an advance of £4 15s. to £3 10s., according to position. The position of cash tin is much stronger, due to the continuous fall in the stocks. Straits cash tin here is now worth about £185, and smelters out there have effected c.i.f. sales up to £186. Within the past two months the American tin market has on several occasions shot upwards, but in each and every instance the advance has been brought to a halt by the failure of the home consumers to buy. Much has been said about the cheapness of tin, and consumers are not disposed in any way to argue the point, but with business in its present condition they see no good reason for the market advancing, and have regularly refrained from buying on the rises. Cable advices from the East reporting a further advance in Straits tin, acted with stimulating effect at Monday's opening market, which after some fractional fluctuations, closed firm with higher values marked for both cash and three months. English ingots also showed a further advance of 20s. at £181 to £182. The weekly return of stocks in London warehouses shows a decrease of 120 tons at 3,224 tons, Liverpool stocks being 81 tons lighter at 2,344 tons, with the stock in Swansea unaltered at 66 tons. Closing prices:—Cash: Wednesday, £180 15s.; Thursday, £181 5s.; Friday, £183 5s.; Monday, £184; Tuesday, £181. Three months: Wednesday, £182; Thursday, £182 5s.; Friday, £183 15s.; Monday, £184 10s.; Tuesday, £181 10s.

**Spelter.**—Renewed activity in this section of the market was resumed at the week's opening, demand on consuming account being brisk, and a large turnover resulting. Values, however, took a slightly downward turn, closing 5s. down on balance. There were buyers of May at £28 5s., June sold £27 15s. to £28, July £28 10s to £28 5s., and August £28 10s. Closing prices: Wednesday, £28 2s. 6d.; Thursday, £28 5s.; Friday, £28 7s. 6d.; Monday, £28 5s.; Tuesday, £28 5s.

**Lead.**—Offerings coming forward more freely, values were inclined to recede, good soft pig on near and forward account easing 2s. 6d. May, June, and July were quoted £24 7s. 6d.. August sold at £24 10s., September at the same figure, while English closed lower at £25 5s. American price spot 5.00c. (£28).

West Indian Nickel Deposits. — Information in regard to nickel deposits in the West Indies has been received by the Department of Overseas Trade (35, Old Queen Street, Westminster, S.W.1). The nickel content is stated to be good Further particulars may be obtained on application to the Department, quoting reference 3626/F.I./P.N.

World's Output of Spelter.—According to figures published by Messrs. Rudolf Wolff & Company the world's total output of spelter in 1920 was 698,875 tons, as compared with 635,496 in 1919 and 983,540 in 1913. To the 1920 output Belgium contributed 77,245 tons; Germany, 94,241 tons; France, 19,822 tons; the United Kingdom, 14,766 tons; ditto, refiners, 7,585 tons; Holland, 2,000 tons; Yugoslavia 1,800 tons; Czecho-Slovakia, 4,200 tons; Poland, 8,000 tons; Spain, 6,309 tons; Scandinavia, 14,385 tons; Australia, 9,665 tons; the United States, 413,000 tons; Japan, 8,000 tons; and Canada, 17,857 tons. The 1913 output of Europe was 671,325 tons; of the United States, 308,549 tons; and of Australia, 3,666 tons.

**MISCELLANEOUS** advts., see also page 16.

Large quantities BALL BEARINGS (new and second hand).
SPECIFICATION STEEL, ⅝ in. to 1¾ in.
HIGH SPEED and CARBON DRILLS, ⅜ in. to 2 in. (all new).
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## COPPER.

| | £ | s. | d. |
|---|---|---|---|
| Standard cash .. .. | 74 | 0 | 0 |
| Three months .. .. | 74 | 0 | 0 |
| Electrolytic .. .. | 76 | 0 | 0 |
| Tough .. .. .. | 75 | 15 | 0 |
| Best selected .. .. | 76 | 0 | 0 |
| Sheets .. .. .. | 116 | 0 | 0 |
| India .. .. .. | 116 | 0 | 0 |
| Wire bars .. .. | 76 | 0 | 0 |
| Do. June .. .. | 76 | 0 | 0 |
| Do. July .. .. | 76 | 0 | 0 |
| Ingot bars .. .. | 75 | 15 | 0 |
| H.C. wire rods .. .. | 83 | 0 | 0 |
| Off. aver. cash, Apr. | 69 | 8 | 11⅝ |
| Do. 3 mths., Apr. .. | 69⅞ | 9 | 2⅝ |
| Do. Settlement Apr. | 69 | 8 | 6⅝ |
| Do. Electro. Apr. .. | 72 | 16 | 2½ |
| Do. B.S., Apr. .. | 71 | 6 | 8 |
| Aver. spot, copper .. Apr. .. .. .. | 69 | 7 | 10¼ |
| Do. Electro, Apr. .. | 73 | 16 | 8 |
| Solid drawn tubes .. | | 15½ | d. |
| Brazed tubes .. .. | | 15½ | d. |
| Wire .. .. .. | | 12 | d. |
| Yellow metal rods .. | | 8½ | d. |
| Do. 4x4 Squares .. | | 10¼ | d. |
| Do. 4x3 Sheets .. | | 10¼ | d |

## BRASS.

| | |
|---|---|
| Solid drawn tubes .. | 13½d. |
| Brazed tubes .. .. | 16½d |
| Rods .. .. .. | 12½d. |
| Sheets to 10 w.g. .. | 11½d. |
| Wire .. .. .. | 11½d. |
| Rolled metal .. | 11½d. |

## TIN.

| | £ | s. | d. |
|---|---|---|---|
| Standard cash .. | 181 | 0 | 0 |
| Three Months .. | 181 | 10 | 0 |
| English .. .. .. | 178 | 0 | 0 |
| Bars .. .. .. | 184 | 0 | 0 |
| Chinese .. .. .. | 179 | 0 | 0 |
| Straits .. .. .. | 187 | 0 | 0 |
| Australian .. .. | 187 | 0 | 0 |
| Eastern .. .. | 186 | 0 | 0 |
| Banca .. .. .. | 194 | 0 | 0 |
| Off. aver., cash, Apr. | 164 | 0 | 11⅜ |
| Do. 3 mths., Apr .. | 166 | 19 | 4½ |
| Do. Sttlment., Apr | 164 | 0 | 0 |
| Aver. spot, Apr. .. | 163 | 19 | 7½ |

## SPELTER.

| | £ | s. | d. |
|---|---|---|---|
| Ordinary .. .. | 28 | 5 | 0 |
| Remelted .. .. | 24 | 0 | 0 |
| Hard .. .. .. | 17 | 0 | 0 |
| Electro 99.9 .. .. | 36 | 10 | 0 |
| English .. .. .. | 32 | 0 | 0 |
| India .. .. .. | 22 | 15 | 0 |
| Prime Western .. | 29 | 5 | 0 |
| Zinc dust .. .. | 50 | 0 | 0 |
| Zinc ashes .. .. | 6 | 0 | 0 |
| Off. aver., Apr. .. | 26 | 1 | 5⅝ |
| Aver., spot, Apr. .. | 25 | 10 | 7 |

## LEAD.

| | £ | s. | d. |
|---|---|---|---|
| Soft foreign ppt .. | 24 | 2 | 6 |
| English .. .. .. | 25 | 5 | 0 |
| Off. average, Apr. .. | 20 | 16 | 10½ |
| Average spot, Apr | 20 | 11 | 9½ |

## ZINC SHEETS.

| | £ | s. | d. |
|---|---|---|---|
| Zinc sheets, spot .. | 36 | 0 | 0 |
| Do. V.M. ex. whf | 36 | 0 | 0 |
| Do. ppt., f.o.b., N.Y. .. .. | | — | |
| Dutch .. .. .. | 36 | 0 | 0 |
| Boiler plates .. .. | 33 | 0 | 0 |
| Battery plates .. | 32 | 10 | 0 |

## ANTIMONY.

| | £ | s. | d. |
|---|---|---|---|
| English regulus .. | 37 | 0 | 0 |
| Special brands .. | 42 | 0 | 0 |
| Chinese .. .. .. | 24 | 10 | 0 |
| Crude .. .. .. | 18 | 10 | 0 |

## QUICKSILVER.

| | £ | s. | d. |
|---|---|---|---|
| Quicksilver. .. .. | 11 | 2 | 6 |

## FERRO-ALLOYS AND STEEL-MAKING METALS.

| | |
|---|---|
| Ferro-silicon— | |
| 45/50% .. .. | £16 10 0 |
| 75% .. .. | £23 10 0 |
| Ferro-vanadium— | |
| 35/40% .. | 22/6 lb. va. |
| Ferro-molybdenum— | |
| 70/80% .. | 8/- lb. mo. |
| Ferro-titanium— | |
| 23/25%, carbonless | 1/6 lb. |
| Ferro-phosphorus, 20/23%, | £32 |
| Ferro-tungsten— | |
| 80/85%, carbon free | 1/10 lb. |
| Tungsten metal powder— | |
| 98/99% .. .. | 2/3 lb. |
| Ferro-chrome— | |
| 4/6% car. .. .. | £37 0 |
| 6/8% car. .. .. | £36 |
| 8/10% car. .. | £35 10 |
| Ferro-chrome— | |
| Max. 2% car. .. | £84 |
| Max. 1% car. .. | £100 |
| Max. 0.75% car. .. | £115 |
| 65/75%, carbonless | 2/9 lb. |
| Nickel—99·8%, cubes or pellets .. | £190 |
| Cobalt metal—97%. . | 16/- lb. |
| Aluminium—98/99% | £150 |
| Metallic Chromium— | |
| 98/99% .. .. | 6/6 lb. |
| Ferro-manganese— | |
| 76/80%, loose .. | £20 |
| 76/80%, packed .. | £21 |
| 76/80%, export .. | £18 |
| Metallic manganese— | |
| 98/99%, carbonless | 3/- lb. |
| Per ton unless otherwise stated. | |

## HIGH-SPEED TOOL STEEL.

| | |
|---|---|
| Finished bars, 14% tungsten .. .. | s. d. 3 0 |
| Finished bars, 18% tungsten .. .. | 3 9 |
| Scrap pieces .. .. | 5d. |
| Turnings and swarf .. | 3d. |
| Per lb. net, d/d buyers' works. | |
| Extras— | |
| Rounds and squares 3 in. to 8 in. inclusive | 4d. lb. |
| Rounds and squares under ½ in. to ¼ in. | 3d. lb. |
| Flats under 1 in. by ⅛ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness .. .. | 3d. lb. |
| Bevels of approved sizes and sections .. | 6d. lb. |
| If in coils .. .. | 3d. lb. |
| Packing .. .. | 4s. cwt |
| Bars cut to length | 10% extra |
| Scrap from high-speed tool steel— | |
| Scrap pieces .. .. | 5d. |
| Turnings and swarf .. | 3d. |
| Per lb. net, d/d steel makers' works. | |

## SCRAP.

| South Wales—£ s. d. | £ | s. | d. |
|---|---|---|---|
| Heavy Steel | 3 | 0 | 0 |
| Bundled steel & shearings | 2 | 15 | 0 |
| Mixed iron & steel .. 1 0 0 | 3 | 10 | 0 |
| Heavy cast iron .. | 3 | 15 | 0 |
| Good machinery for foundries .. | 6 | 0 | 0 |
| Cleveland— | | | |
| Heavy steel .. | 2 | 10 | 0 |
| Steel turnings .. | 2 | 7 | 6 |
| Cast-iron borings | 2 | 7 | 6 |
| Heavy wrought iron piling .. .. | 3 | 10 | 0 |
| Bundling scrap .. | 4 | 5 | 0 |
| Cast-iron scrap .. | 5 | 10 | 0 |
| Lancashire— | | | |
| Cast iron scrap .. | 6 | 0 | 0 |
| Heavy wrought .. | 3 | 0 | 0 |
| Steel turnings .. | 1 | 10 | 0 |
| London— | | | |
| Copper (clean) .. | 51 | 0 | 0 |
| Brass (clean) .. | 30 | 0 | 0 |
| Lead (less usual draft) .. .. | 18 | 10 | 0 |
| Tea lead .. .. | 16 | 10 | 0 |
| Zinc .. .. | 13 | 0 | 0 |
| New aluminium cuttings .. | 70 | 0 | 0 |
| Braziery copper .. | 41 | 0 | 0 |
| Gun metal .. | 45 | 0 | 0 |
| Hollow pewter .. | 135 | 0 | 0 |
| Shaped black pewter .. .. | 80 | 0 | 0 |

## PIG-IRON.

| | |
|---|---|
| N.-E. Coast— | |
| Foundry No. 1 .. | 125/- |
| Foundry No. 3 .. | 120/- |
| Forge No. 4 .. .. | 117/6 |
| Mottled .. .. | 117/6 |
| Hematite No. 1 .. | 162/6 |
| Hematite M/Nos. .. | 160/- |
| Midlands— | |
| Staffs. common .. | 145/- |
| „ part-mine forge | 160/- |
| „ „ foundry | 170/- |
| „ Cold blast .. | 320/- |
| „ basic .. .. | 140/- |
| Northants forge .. | 140/- |
| „ foundry No. 3 | 147/6 |
| „ basic .. .. | 140/- |
| Derbyshire forge .. | 150/- |
| „ foundry No. 3 | 160/- |
| „ basic .. | 150/- |
| Scotland— | |
| Foundry No. 1 .. | 170/- |
| „ No. 3 .. | 165/- |
| Hematite M/Nos. .. | 180/- |
| Sheffield (d/d district)— | |
| Derby forge .. .. | 155/- |
| „ foundry No. 3 | 160/- |
| „ basic .. .. | 155/- |
| Lincs. forge .. .. | 160/- |
| „ foundry No. 3 | 170/- |
| „ basic .. .. | 162/6 |
| E.C. hematite .. | 173/- |
| W.C. hematite .. | 196/- |
| All d/d in the district. | |
| Lancashire (d/d eq. Man.)— | |
| Derby forge .. .. | — |
| „ foundry No. 3 | 170/- |
| Northants foundry No. 3 .. .. | — |
| Cleveland foundry No. 3 .. .. | — |
| Staffs. foundry No. 3 | — |
| Lincs. forge .. .. | 172/6 |
| „ foundry No. 3 | 177/6 |
| Summerlee foundry .. | 193/- |
| Glengarnock foundry | 195/6 |
| Gartsherrie foundry | 193/- |
| Monkland foundry .. | 193/- |

## FINISHED IRON & STEEL.

| Iron— | £ | s. | d. |
|---|---|---|---|
| Bars (cro'n) | 19 | 0 | 0 |
| Angles .. | 19 | 10 | 0 |
| Tees to 3 united ins. .. | 20 | 0 | 0 |
| Nut and bolt .. | 19 | 0 | 0 |
| Hoops .. .. | 23 | 0 | 0 |
| Marked bars (Staffs.) .. | 27 | 10 | 0 |
| Gas strip .. | 22 | 0 | 0 |
| Bolts and nuts, ¾ in. × 4 in. | 38 | 0 | 0 |
| Steel— | | | |
| Ship plates .. | 19 | 0 | 0 |
| Boiler plates .. | 25 | 0 | 0 |
| Checquer plates | 20 | 0 | 0 |
| Angles .. .. | 17 | 10 | 0 |
| Tees .. .. | 18 | 10 | 0 |
| Channels .. | 18 | 0 | 0 |
| Joists .. .. | 17 | 10 | 0 |
| Rounds, ⅝ in.–3-in. .. .. | 14 | 0 | 0 |
| Rounds, 3 in.–5¼ in. .. | 13 | 0 | 0 |
| Flats, 5 in.–8 in. | 14 | 10 | 0 |
| Flats over 8 in. | 13 | 0 | 0 |
| Rails, heavy .. | 15 | 0 | 0 |
| Fishplates .. | 20 | 0 | 0 |
| Hoops .. .. | 16 | 10 | 0 |
| Black sheets, 24 g. | 19 | 10 | 0 |
| Galv. cor. sheets, 24 g. .. .. | 22 | 0 | 0 |
| Galv. fencing wire, 8 g. plain .. | 23 | 10 | 0 |
| Rivets, ¾ in. dia | 27 | 0 | 0 |
| Billets, soft .. | 11 | 10 | 0 |
| Billets, hard .. | 12 | 10 | 0 |
| Sheet and tin bars | 11 | 10 | 0 |

## PHOSPHOR BRONZE.

| Rolled. | Per lb. s. | d. |
|---|---|---|
| ½ in. to 1 in. wide .. | 1 | 9½ |
| 1 in. to 1½ in. wide .. | 1 | 9½ |
| 1½ in. to 2 in. wide .. | 1 | 7½ |

| Strips. | s. | d |
|---|---|---|
| 2 in. to 6 in. to 26 S.W.G. | 1 | 7½ |
| 6 in. to 12 in. to 26 S.W.G. .. .. | 1 | 7½ |

| Sheets. | s. | d. |
|---|---|---|
| 12 in. to 18 in. to 24 S.W.G. .. .. | 1 | 7½ |
| 18 in. to 24 in. to 24 S.W.G. .. .. | 1 | 8½ |
| 24 in. to 30 in. to 20 S.W.G. .. .. | 1 | 9½ |
| 30 in. to 36 in. to 16 S.W.G. .. .. | 1 | 9¾ |
| 36 in. to 42 in. to 16 S.W.G. .. .. | 1 | 10¾ |

Extras.

For Gauge: Any width up to 36 in. wide, ½d. per lb. per thinner gauge.

| Drawn Rods. | s. | d |
|---|---|---|
| ¼ in. to ⅞ in. dia. in random lengths / ⅛ in. to 1½ in. dia. in random lengths | 1 | 8 |
| Over 1½ in. to 1¾ in. .. | 1 | 8 |
| Tubes—basis price .. | 1 | 9¾ |

Delivery 2 cwt. free to any town.

10% phosphor copper, £40 above price of B.S.

15% phosphor copper, £50 above price of B.S.

Phosphor tin (5%), £30 above price of English ingots.

Charles Clifford & Son, Limited, Birmingham.

## NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

| | Per lb. |
|---|---|
| Ingots for raising | 1/1 to 1/7 |
| Rolled— | |
| To 9 in. wide | 1/8½ to 2/2½ |
| To 12 in. wide | 1/9 to 2/3 |
| To 15 in. wide | 1/10 to 2/4 |
| To 18 in. wide | 1/11 to 2/5 |
| To 21 in. wide | 2/- to 2/6 |
| To 24 in. wide | 2/1 to 2/7 |
| Ingots for spoons and forks .. | 1/1 to 1/7 |
| Ingots rolled to spoon size .. | 1/4 to 1/10 |
| Wire round— | |
| 3/0 to 10. G. .. | 1/11 to 2/6 |

with extras according to gauge

## AMERICAN IRON & STEEL.

| At Pittsburgh unless otherwise stated. | Dols. |
|---|---|
| No. 2X foundry, Phila. | 25.81 |
| No. 2 foundry Valley .. | 24.50 |
| No. 2 foundry, Birm. .. | 22.00 |
| Basic .. .. .. | 23.96 |
| Bessemer .. .. | 25.96 |
| Malleable .. .. | 25.96 |
| Grey forge .. .. | 23.46 |
| Ferro-manganese 80 % delievred .. .. | 85.00 |
| Bess. rails, h'y, at mill | 45.00 |
| O.-h. rails, h'y, at mill | 47.00 |
| Bess. billets .. .. | 37.00 |
| O.-h. billets .. .. | 37.00 |
| O.-h. sheet bars .. | 39.00 |
| Wire rods .. .. | 48.00 |
| | Cents. |
| Iron bars, Phila. .. | 2.35 |
| Steel bars .. .. | 2.10 |
| Tank plates .. .. | 2.20 |
| Beams, etc. .. .. | 2.20 |
| Skelp, grooved steel .. | 2.20 |
| Skelp, sheared steel .. | 2.20 |
| Steel hoops .. .. | 2.75 |
| Sheets, black, No. 28 .. | 4.00 |
| Sheets, galv., No. 28 .. | 5.00 |
| Sheets, blue an'l'd, 9&10 | 3.10 |
| Wire nails .. .. | 3.25 |
| Plain wire .. .. | 3.00 |
| Barbed wire, galv. .. | 4.00 |
| Tinplate, 100-lb. box .. | $6.25 |

## COKE.

| | |
|---|---|
| Welsh foundry .. .. | 67/6 |
| „ furnace .. .. | 55/- |
| Durham & North. foundry | 70/- |
| „ furnace | 42/6 |
| Other Districts, foundry | 77/9 |
| „ furnace | 45/- |

### SWEDISH IRON.

Bars, hammered basis sizes Basis price £31 to £32

| | |
|---|---|
| Rolled Ordinary— Assortment .. | £ s. d. 22 10 0 to 23 10 0 |
| Nail Rods— Square, round and flats .. | |
| Keg Steel } about Faggot Steel } £40 | Prices nominal. |

Blooms—
Single welded .. £16 to £18

Billets—
Single and double welded .. £18 to £23

Pig-Iron—
Grey, white or mottled ..£12/10 to £14

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

### TUBES.

| | Up to and incl. 2 in. | Over 2 in. |
|---|---|---|
| Gas .. | −15% | −20% |
| Water .. | − 5% | −11½% |
| Steam .. | + 6¼% | − 1¼% |

### TINPLATES.

| | | |
|---|---|---|
| I.C. Cokes, | 20×14, box | 26/- |
| ,, | 28×20, ,, | 53/- |
| ,, | 20×10, ,, | 37/- |
| ,, | 18¾×14, ,, | 30/- |
| I.X. | ,, | 44/- |
| I.X.X. | ,, | 88/- |
| F.C.B.Y. | 21×13⅝ ,, | 50/6 |
| C.V.B.G. | 16½×15, ,, | 50/- |
| I.C.W. | 20×14, ,, | 21/6 |
| ,, | 28×20, ,, | 40/- |
| ,, | 20×10, ,, | 29/- |
| ,, | 18¾×14, ,, | 20/- |
| Terneplates, | 28×20, ,, | 54/- |

### DAILY FLUCTUATIONS.

**Standard Copper** (cash).

| | £ | s. | d. | | |
|---|---|---|---|---|---|
| May18 | 74 | 10 | 0 | inc. | 7/6 |
| ,, 19 | 74 | 17 | 6 | ,, | 7/6 |
| ,, 20 | 75 | 5 | 0 | ,, | 7/6 |
| ,, 23 | 75 | 10 | 0 | ,, | 5/- |
| ,, 24 | 74 | 0 | 0 | dec. | 30/- |

**Electrolytic Copper** (Cash).

| | | | | |
|---|---|---|---|---|
| May18 | 75 | 0 | 0 | inc. 10/- |
| ,, 19 | 75 | 0 | 0 | No change |
| ,, 20 | 76 | 0 | 0 | inc. 20/- |
| ,, 23 | 76 | 0 | 0 | No change |
| ,, 24 | 76 | 0 | 0 | ,, |

**Standard Tin** (cash).

| | | | | | |
|---|---|---|---|---|---|
| May18 | 180 | 15 | 0 | dec. | 5/- |
| ,, 19 | 181 | 5 | 0 | inc. | 10/- |
| ,, 20 | 181 | 5 | 0 | ,, | 40/- |
| ,, 23 | 184 | 0 | 0 | ,, | 15/- |
| ,, 24 | 181 | 0 | 0 | dec. | 60/- |

**Tin** (English Ingots)

| | | | | | |
|---|---|---|---|---|---|
| May18 | 177 | 0 | 0 | dec. | 20/- |
| May19 | 179 | 0 | 0 | inc. | 40/- |
| ,, 20 | 181 | 10 | 0 | ,, | 40/- |
| ,, 23 | 182 | 0 | 0 | ,, | 20/- |
| ,, 24 | 179 | 0 | 0 | dec. | 60/- |

**Zinc Sheets** (spot).

| | | | | |
|---|---|---|---|---|
| May18 | 36 | 0 | 0 | No change |
| ,, 19 | 36 | 0 | 0 | No change |
| ,, 20 | 36 | 0 | 0 | No change |
| ,, 23 | 36 | 0 | 0 | No change |
| ,, 24 | 36 | 0 | 0 | No change |

**Spelter** (ordinary).

| | | | | | |
|---|---|---|---|---|---|
| May18 | 28 | 2 | 6 | inc. | 17/6 |
| ,, 19 | 28 | 5 | 0 | ,, | 2/6 |
| ,, 20 | 28 | 7 | 6 | ,, | 2/6 |
| ,, 23 | 28 | 5 | 0 | dec. | 2/6 |
| ,, 24 | 28 | 5 | 0 | No change | |

**Lead** (English).

| | | | | | |
|---|---|---|---|---|---|
| May18 | 25 | 0 | 0 | inc. | 5/- |
| ,, 19 | 25 | 15 | 0 | inc. | 15/- |
| ,, 20 | 25 | 15 | 0 | No change | |
| ,, 23 | 25 | 10 | 0 | dec. | 5/- |
| ,, 24 | 25 | 5 | 0 | ,, | 5/- |


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5959 Central.

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BARS, ANGLES, TEES and PLATES.

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**R.D. ♔**
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**MILD STEEL (up to 2in. wide)**
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Lancashire Boiler, 30 ft. x 8 ft., for 120 lbs. w.p.
Loco. Type Boiler, by Robey, 105 lbs. w.p.
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One 12-TON GEARED LADLE, 5 ft. 6 in. diam. at top, 3 ft. 11 in. deep, fitted with bevel and worm gearing for tilting.

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One LADLE WITH CARRIAGE (Stevensons, Preston), the Ladle being 3 ft. 4 in. diam. at top, 3 ft. 4 in. deep: worm gearing for tilting; carriage, 5 ft. gauge.

Seven CIRCULAR CENTRE-TIPPING CRANE SKIPS, each about ¾ cubic yard capacity.

One New 4-FT. LOAM MILL, under-driven, fitted with one plain and one cogged roller, each 23-in. diam. x 7½-in. face

One 3-TON "AVERY" SUSPENDED CRANE WEIGHING MACHINE, with two steelyards.

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Two 5-TON "AVERY" PORTABLE PLATFORM WEIGHING MACHINES, each with platform 4 ft. 6 in. by 4 ft. 6 in., and mounted on four wheels.

NEW "FAIRBANKS" PORTABLE PLATFORM WEIGHING MACHINES, 5, 7, and 10-cwt. sizes; all stamped and ready for immediate work.

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"ABRAHAM" PORTABLE MOULDING MACHINES,
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WANTED, Foundry Sand Grinding Mill. Pan 4 ft. dia. or thereabouts, with two cogged wheels, belt driven. Give lowest cash price.—PICKUP, Brook Street, Scarborough.

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*For continuation of small advertisements see page* 484.